THE

ELECTRICAL REVIEW.

VOL. LIX. DECEMBER 7, 1906. No. 1,515.

ELECTRICAL REVIEW.

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THE

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(J. A. BERLY'S).

1907 Edition

TO APPEAR IN JANUARY.

Advertisements, new names and corrections to existing entries should be sent in at once.

THE VICTORIA FALLS POWER SCHEME.

THE Engineering Supplement of the *Times* for November 28th contains a double-column article which bears a suspicious resemblance to those fascinating and well-written columns which appear almost daily in the *Times* itself under the note that they are from the pen of a member of the *Times* advertising staff after close personal investigation of the brandy, or of the cure for brandy, or of whatever other article the advertisers are desirous to bring before the public.

This "Supplement" article bears no such label, and the effect on the wary reader is to make him read the whole thing by paragraphs, beginning from the end, in order that he may prevent Mother Seigel or some equally wily old lady scoring off him once again, for in such cases he feels that there is no hit if the stroke has been anticipated.

The only way actually to prove that this *Times* article is an advertisement is by referring to the "Contents." It is omitted from the index of Editorial contents, but is included under the Advertisers' list. Would one reader out of a hundred notice this, and noting it appreciate what it really meant? But even this disclosure has apparently caused displeasure, for in the Supplement for December 5th there is another write-up of the scheme, booming its claimed advantages, but this article is indexed neither under Editorial nor under Advertisement Contents! Surely the *Times* has fallen from its high estate when it lends itself to this sort of thing!

It was only necessary to read the puff preliminary, to earmark at once all available assets in readiness for the opening of the subscription lists.

A 50,000-H.P. initial hydraulic turbine generating station at the Falls, a 600 or 700 miles transmission line, an immense hydraulic accumulator and a reserve steam station on the Rand itself. That is the simple scheme, and it will work as follows:—The Falls station will generate continuously at a load factor of 100 per cent., for the fluctuations in the load at the Rand will be smoothed out "by raising water to a position where it is conserved, and where it is instantly available for the reproduction of electric power at such times as it is required." But the Rand consumers would not enter into contracts with continuity of supply depending on the integrity of 600 or 700 miles of transmission wires, plus the few hours' reserve of the hydraulic accumulator, so the reserve steam station is to be available for such emergencies. As the mine-owners have insisted on continuity of supply under all conditions, it is obvious that the reserve steam station must be of the same capacity, less something for transmission losses, as the Falls station, and it is noticeable that the article omits to make any point at all of the magnificence of the *combined* load factor.

We shall not be knocked out of time by astonishment when we hear that the reserve steam station is to be erected first—*by a long way!*

We enter into a fuller discussion of the scheme on another page of this issue. The promoters think they can throw cold water on all criticism which is advanced by boastfully pretending that the views of no experts other than their own are worth considering. "Insist upon the production of their credentials," impertinently says Mr. Wilson Fox, "in regard to their right to speak with authority as practical engineers upon questions involving the transmission of power over long distances." Statements of this kind and suggestions that all expert criticism is influenced by a rival undertaking may play a part in the persuasion of the public, but they are not likely to be regarded seriously by engineers.

Two very important dispatches have been sent by Reuter's agents at Berlin and Johannesburg, which ought to be given the widest publicity possible when the British South Africa Co. seems to be "working" the Press of the country in its favour. Here is the one from Johannesburg :—

Johannesburg, *December 3rd.*

The Government has refused the application of the African Concessions Syndicate for power to construct an electric power line through the Witwatersrand, on the ground that the syndicate does not comply with the laws of the colony as it is not working a mine or carrying on any works.

And here follows that dispatched from Berlin :—

The prospectus of the South African electric power scheme, in which a number of German banks are financially interested, and the great Berlin electrical company, the Allgemeine Elektrizitäts-Gesellschaft, is concerned, will appear shortly. The *Berliner Tageblatt* understands that the scheme is on a much smaller scale than at first planned, and that for the present there is no question of harnessing the Victoria Falls. The Allgemeine Elektrizitäts-Gesellschaft will erect a power station of 20,000 H.P. in the neighbourhood of Johannesburg on behalf of the English company. The promoters of the scheme are the Chartered Co. The possibility of eventually harnessing Victoria Falls will, according to the *Tageblatt*, be reserved. In the new company's statutes the services of the German company will be repaid by the apportionment of Preference shares in the new company to the German financial group.—*Reuter.*

It is satisfactory to see that all criticism has not been stifled. The *Pall Mall Gazette* has rendered splendid service on previous occasions when independent straight-talking has been needed, and we cannot refrain from quoting a plainly-spoken criticism which appeared in its issue of Tuesday :—

The more we hear about this matter the more amazing and incredible the whole thing becomes. For several days past many papers have been spreading themselves on preliminary puffs, and to-day there is an exhibition at the Chartered Co. Museum of the models, plans, &c., connected with the scheme. Exactly what useful purpose this is expected to serve is difficult to understand, but the Banket advertisement of the same character was so successful that it is probably hoped to achieve equally brilliant results on this occasion. But before the scheme got to this stage we should have at least expected to learn on official authority what support the scheme had obtained from the Transvaal mines, and whether contracts for the supply of power had been entered into with the leading groups. The silence on this most essential factor was significant, but to-day's news may help to explain it. A Reuter telegram from Johannesburg states that the Government have refused the application of the Africa Concessions Syndicate for rights to construct an electric power line through the Witwatersrand! It seems absolutely incredible that all these preliminary arrangements should have been made and contracts entered into with the German Electric Co. before this indispensable authority was obtained, but Reuter does not often make mistakes in matters of that kind. Anyhow, the next stage in this extraordinary venture will be awaited with increasing interest as the result of this latest development, but meantime the laughter is hard to suppress.

L.C.C. Tramway Accounts.

The proceedings at Tuesday's meeting of the L.C.C. were enlivened by some strong observations on the motion for the reception of the report of the Finance Committee. Sir J. W. Benn asked whether, in view of the statements published in the newspapers alleging that the tramways accounts were cooked, which assertions he stated were lying statements, the chairman could see his way to bringing up at an early date a full and authoritative statement in regard to the tramway accounts. Sir M. Beechcroft and Colonel Rotton protested against the use of such language, and the chairman of the Council was asked whether such remarks were in order. After being pressed on the question, Mr. Evan Spicer stated that he did not think it wise to employ such expressions in the Council chamber, and he ruled them out of order. Sir J. W. Benn, in withdrawing the observation on the chairman's ruling, substituted for lying statements the words "sentiments which are opposed to accuracy." Lord Welby, chairman of the Finance Committee, then stated that bearing in mind the misunderstandings and misrepresentations on the subject of the tramways, it appeared that the production of the suggested statement was eminently desirable. He had, therefore, taken the opportunity of speaking to the Comptroller with a view to the preparation of such a return showing the financial results up to the present time of the Council's tramways north and south of the Thames. We thoroughly agree that a plain unvarnished statement is needed. We could wish for no better proof that Sir J. W. Benn and his tramway colleagues on the L.C.C. are in the wrong in this matter of tramway finance than angry and abusive utterances. We shall await this new return with considerable interest, but how long before the March elections will it be available? Will it be in time for more of these searching "lying" analyses to be made?

The I.E.E. Dinner.

The annual dinner-conversazione of the I.E.E. last Tuesday passed off with its usual success; the latter part of the programme is highly appreciated by all, and it is a pity that the excellent example of the Institution in this respect is not followed by other societies. Members see but little of one another in the too-brief opportunities afforded after the meetings, which only too often are still further reduced by the protraction of the discussions beyond 9.30. Why should not at least one meeting be set apart for a short discussion on some matter of general interest, closing early enough to allow of at least an hour's chat? At the dinner we heard of an admirable custom, practised in America, of dining together informally in a room reserved for the purpose (without special charge) in a restaurant, before the commencement of a meeting, and this idea seems worthy of adoption.

If the speech-making after the annual dinner were cut still shorter than at present, thus affording more time for conversation, we are quite sure that the great majority would cordially approve, for, as was abundantly proved to us on the last occasion, the speeches are inaudible to very many of the guests, and, we fear, somewhat tedious to those who hear them.

Regarding the amusing skirmish between Colonel Crompton and Captain Hemphill, it appeared that the latter, while emphasising the anxiety of the L.C.C. to hasten the construction of tramways and the supply of electricity in bulk to London, overlooked two facts: one, that it was the County Council, and no other, that delayed electric traction in London for at least five years; the other, that the Council last year bitterly opposed the scheme brought forward by Mr. Merz, upon which it has since based its own.

ELECTRICAL SCHEMES IN PARLIAMENT.

The following summary of schemes, more or less electrical, to be submitted for consideration in the 1907 Session of Parliament, will be perused with interest by our readers, who, however, will find them neither so interesting nor so numerous as at this time last year.

The English applications will, as a rule, be found in full in the *London Gazette*.

The proposals for supplying the Metropolitan area, by the London County Council and four rival syndicates, stand forward as the most prominent; the first named is, of course, the most ambitious scheme, and it will be noted that it contains special clauses relative to the use of gas for generating purposes. Fourteen of the London companies are associated in another scheme, and our old friend the "Administrative" hinges a further proposal on the recommendations of the Select Committee to whom the L.C.C. 1906 Bill was referred. No railway or tramway schemes of special interest are set down for consideration in the coming session.

I.—Electric Lighting and Power Proposals.

Arbroath.—Provisional order for area by Mr. G. Balfour.
Aston Manor.—Extension of Corporation's area of supply.
Bermondsey.—Extension of area of supply.
Bideford.—Prov. order for area by Mutual Electricity Supply Co.
Boston Spa.—Power to apply for prov. order by Gas Co.
Brighouse.—Further provisions relating to Corporation's electricity supply.
Burnham (Somerset) and District.—Provisional order for the area by a new company.
Carnarvon.—Agreement between Corporation and National Electrical Construction Co., Ltd., and further powers for supply.
Castleford.—Prov. order for area by Electrical Distribution of Yorkshire, Ltd.
Chesham.—Extension of time for carrying out prov. order.
Chesham.—Prov. order by Empire Electric Light and Power Co.
Devonport.—Further provisions; exemption of apparatus on hire [from distress.
Dundee.—Extension of area of supply.
Egham.—Prov. order by syndicate.
Electric Supply Corporation, Ltd.—Transfer to this company of undertakings and orders relating to Exmouth, Hitchin, Sidmouth, Stevenage, Dawlish, Hendon, Teignmouth, Chelmsford and Totnes, in England, also to Dumbarton, Dalkeith, Dollar, Jedburgh and Melrose, in Scotland.
Felixstowe and Walton.—Confirmation of agreement between U.D.C. and Suffolk Electricity Supply Co.
Formby.—Prov. order for U.D.C.
Grays and Tilbury Gas Co.—Supply of electrical energy.
Greetland.—Prov. order for area by Electrical Distribution of Yorkshire, Ltd.
Grimsby.—Extension of Corporation's electricity supply in adjoining areas.
Halesowen.—Prov. order by Shropshire, Worcestershire and Staffordshire Electric Power Co. for area.
Haslingden, Rawtenstall, Bacup and Ramsbottom.—Application by Lancashire Electric Power Co. for a prov. order for supply in these areas.
Henley-on-Thames.—Prov. order for Henley and District by Mutual Electricity Supply Co.
Hipperholme.—Amendment of U.D.C.'s prov. order; extension of time, &c.
Leicestershire and Warwickshire Electric Power Co.—Extension of time; provision for overhead transmission.
Liversedge.—Prov. order for area by Electrical Distribution of Yorkshire, Ltd.
Lytham.—Prov. order by U.D.C.
Maldens and Coombe.—Provisional order by County of London Electric Supply Co.
Mansfield.—Extension of Corporation area of supply.
Middlesbrough.—Power for Corporation to work transporter bridge by electric power.
Minehead and Dunster.—Provisional order for electric lighting in Minehead and district.
Newark.—Alteration and amendment of Corporation's prov. order.
Ogmore and Garw.—Powers for U.D.C. to purchase undertaking, &c., of Ogmore Valley Electric Light and Power Co.
Oxford and District.—Power for tramways company to take transfers of prov. orders.
Paignton.—Prov. order for area by Western Electricity Corporation.
Penrith.—Amendment of U.D.C.'s prov. order.
Pontefract.—Prov. order for area by Electrical Distribution of Yorkshire, Ltd.
Pontefract.—Application for prov. order by Corporation; supply in bulk from or to other authorities; hire of apparatus, &c.
Pontypridd.—Appropriation of land for electrical purposes.
Rawtenstall.—Further provisions in regard to Corporation's undertaking.
Rhymney Valley.—Provisional order by Rhymney Valley and General Electric Supply Co.
Richmond (Surrey).—Confirmation of company's powers to supply.
St. Albans and District.—Prov. order to enable St. Albans Co. to transfer undertaking to North Metropolitan Electrical Power Distribution Co.
Scottish Central Electric Power Co.—Provisional order for parts of Falkirk, Larbert, Grangemouth, Denny, Dumpace, Kilsyth and Glamannan, and for parish of Cambernauld.
Shanklin.—Application by Gas Co. for prov. order.
Sheffield.—Supply in bulk by Corporation to neighbouring areas.
Somerset and District Electric Power Co.—Acquirement of prov. orders and other matters.
Smethwick.—Provisional order for electric supply in area by Birmingham and Midland Tramways, Ltd.; further powers for tramway supply.
Stockport.—Special clauses as to Corporation supply in certain cases.
Stoke-upon-Trent.—Extension of supply area.
Sunderland.—Provision as to charges in special cases.
Tunbridge Wells.—Special charges by Corporation in certain cases.
Westhoughton, Hindley, Abram and Aspull.—Application by Lancashire Electric Power Co. for prov. order to supply these districts.
Worsley, Whitefield, Kearsley and Tyldesley-with-Shakerley.—Application by Lancashire Electric Power Co. for prov. order to supply these districts.

London Power Proposals.

London County Council.—To generate and supply electrical energy in the County of London and portions of the counties of Essex, Kent, Surrey and Middlesex; purchase or transfer to Council of undertakings and powers of authorised distributors; transfer of powers of purchase of local authorities; powers to Council and authorised distributors to supply machinery and fittings, &c.

The Council asks for power to manufacture gas for the purpose of generating electrical energy; to acquire sites at Barking and Erith on the River Thames; to lay cables on railway property, &c. Some 70 municipal and company undertakings are cited for transference to, vesting in, or acquirement by the L.C.C.

Administrative County of London and District Electric Power Co.—To incorporate a company to enter into agreements with the L.C.C., with a view either to undertaking a partial supply in the London area, or to leasing from the L.C.C. the whole undertaking during the initial stages.
North Metropolitan Electric Power Supply Co.—Extension of powers of company in counties of Middlesex, Hertford and Essex, and metropolitan borough of Stoke Newington; transferring and leasing undertakings of local authorities and companies; supply to railways, &c.
London and District Power.—A company to generate and supply electricity in parts of the administrative county of London, and counties of Essex, Kent and Surrey. Lands are scheduled in Barking and Greenwich, and some sixty authorities are cited as forming part of the proposed area.
London Electric Supply.—Constitution of Joint Committee of London Electric Supply Companies; amalgamation of undertakings; provisions for joint supply in area, which includes administrative county of London and parts of counties of Essex, Kent, Surrey and Middlesex.

II.—Tramway and Railway Powers.

Audenshaw.—Revival and extension of U.D.C.'s (1899) Tramways Order.
Barnsley, Wombwell and Wath Tramways.—The construction of tramways, generating stations, &c., and acquisition of electric lighting orders, by company.
Birmingham.—Construction of tramways by Corporation.
Central Essex Light Railway.—Extension of time for completion of works.
Central London Railway.—Construction of short extension railway at Uxbridge Road; subway from company's Bond Street station; and other provisions.
Channel Tunnel Railway.—Powers for electrification.
Clacton-on-Sea and St. Osyth Light Railway.—Abandonment of certain works by company; extensions and deviations.
Dartford District Light Railways.—The revival and extension of period for carrying out works, by company.
Dewsbury.—Notice of intention to lease authorised tramways to British Electric Traction Co., Ltd.
Dundee.—Construction of tramways by Corporation; power to lease same.
Folkestone, Sandgate and Hythe Tramways.—Street widenings by company; power to run motor-omnibuses.
Great Northern and City Railway.—Extension of time for completion of works authorised in 1902.
King's Norton and Northfield.—Reconstruction of tramways and electrification of same by U.D.C.
Huddersfield.—Extension of Corporation tramways.
Kingston-upon-Hull.—Extension of Corporation tramways.
Leeds.—Extension of Corporation tramway system.
Llandudno and Colwyn Bay Light Railway.—Construction of light railways by company.
London and North-Western Railway.—Powers for electrical working of lines.
London County Council.—Construction of electric tramways in St. Pancras, Bloomsbury, Shoreditch, Bethnal Green, Islington, Hackney, Lambeth, Battersea, Wandsworth, &c.; reconstruction of Vauxhall and Loughborough, Loughborough and Norwood, Loughborough and Camberwell, Wandsworth and Vauxhall, and Queen's Road (Battersea) lines.

London United Tramways.—Construction of subway and works at Hammersmith Broadway, &c.
Lower Thames Tunnel Railways.—New railways and provision for electrification of same.
Maidstone.—Construction of light railway by borough.
Manchester.—Extension of Corporation tramway system; extension of time, amendments of Acts; agreement with local authorities, &c.
Middlesbrough, Stockton-on-Tees and Thornaby Tramways.—Extension of routes; abandonment of authorised tramways, extension of time and powers, &c.
Newcastle-upon-Tyne.—Extension of Corporation tramway system; agreements for interchange of traffic with and to work other tramways.
North-East London Railway.—Extension of time.
Oxford and District Tramways.—Transfer of existing tramways to company; construction of new lines; electrification of lines; transfer of prov. orders to company, &c.
Portsdown and Horndean Light Railway.—Construction by Hampshire Light Railways Co. of additional lines; powers for inter-running, &c.
Rawtenstall.—Electrification of existing and construction of new tramways; electrification of tramways in Bacup, by Corporation.
Sheffield.—Extension of Corporation tramways and powers to run motor-omnibuses in connection with tramway system.
Taunton.—Construction of tramway extensions by Taunton Electric Traction Co.
Watford and Edgware Railway.—Extension of time for completion and agreements with other electric railway companies.
West Ham.—Additional electric tramways in the borough by Corporation.
West Riding Tramways.—Extension of time for completion of tramways by Wakefield and District Light Railway Co.
West Yorkshire Tramways.—Street widenings by West Yorkshire Tramways Co.
York and District Tramways.—Reconstruction and extension of tramways; electrification of lines, &c.

VICTORIA FALLS POWER SCHEME.

THREE of the leading newspapers of the day have drawn attention—through their literary and advertising columns—to the great electrical possibilities of the Victoria Falls. We have more than once pointed out the unsoundness of writers in the daily Press on engineering matters, but, in their methods of casting a romantic glamour round what are really ordinary commercial enterprises, the modern journalists more than compensate for their inaccuracy.

The *Daily Telegraph*, which discloses this scheme in the form of a special interview, though it does not differ in detail from what another newspaper frankly indexes in its advertisement columns, gives out that the colossal scheme of transmitting electrical energy from Victoria Falls, entailing an expenditure of six millions, is designed to save the Rand mines at least a million sterling annually.

Apparently the British South Africa Co., having its own special reasons for developing the Victoria Falls, has effected an alliance with a group of German capitalists, and the Allgemeine Elektricitäts Gesellschaft; and this combination, with the aid of many eminent engineers, has elaborated this magnificent project by which electrical energy will be carried over 700 miles of desert, and economically distributed for power purposes on the Rand.

We presume the promoters may be congratulated upon being able to surround themselves with a galaxy of engineering talent. Certainly in their advertising announcements they have been able to marshal a number of well-known names, among them Sir Douglas Fox and Partners, Prof. Blondel, Dr. Edouard Tissot, M. Thury, of Geneva, Mr. Arthur Wright, and Mr. A. W. K. Pierce, consulting engineer to the Consolidated Goldfields. These various eminent experts, on the information put before them, have stated that there are no insuperable objections to carrying out the scheme as outlined in the daily Press. If the engineering details have been as cleverly devised as the advertising, it will be difficult to withhold high praise.

It may be pointed out that the greatest distance to which electrical power is being transmitted at the present moment is under 400 miles. As an engineering achievement it is not impossible to transmit electrical power over a distance of 700 miles, but, having admitted such a possibility, the whole question resolves itself into one of commerce; in other words, is it possible to utilise the Victoria Falls, to transmit electrical energy to the Rand and sell it there at a profit?

The promoters of the scheme suggest that 50,000 H.P. will be the output of the first portion of the plant, and this in all probability will be sufficient to meet the immediate requirements of the Rand. There is no distinct evidence to show whether this amount of power will be utilised, for it must not be forgotten that there are already numerous mines which are supplied with their own plant. Accepting, however, the possibility that 50,000 H.P. could be disposed of among the power users in the Rand district, if the price is low enough, it would be interesting to know what the profit is likely to be after electrical energy has been transmitted over 700 miles. The capacity of the plant is by no means excessive, and is probably but slightly larger than one or two private and municipal undertakings already existing in this country. We are specially making this comparison, because in spite of the enthusiasm with which the promoters speak of the engineering details of their wonderful scheme, they are singularly reticent as to the probable profit. Nay, they even admit a difficulty, for in the course of the interview, Mr. Wilson Fox says: "The crucial question of finance involves a difficulty at the outset, because there are no definite statistics upon which to base calculations. Profits are not too frankly revealed in the case of every electric supply concern; but ample proof that satisfactory profits are being earned is provided by the contemplated enormous extensions of existing installations."

But surely Mr. Fox knows, or, at any rate, some of the engineers of the scheme could have told him, that if there is any lack of frankness in any English supply concern, it is due to the lack of profits, and to no other reason. Moreover, it is because there is so much information available in regard to the operation of electricity supply undertakings that we are able to apply some fairly accurate tests to the earning capacity of the Victoria Falls. In the South African instance it is true we cannot criticise actual figures, because, on the confession of Mr. Fox, they have none to offer. Therefore, this six-million scheme has been decided upon, and details developed, without any knowledge as to what the profits are likely to be. Such a conclusion does not inspire overmuch confidence, but, before dealing conclusively with the financial side of the undertaking, we will consider such engineering details as are given in the daily Press.

The promoters are advised that there will be no difficulty in adopting 150,000 volts for the transmission of the electrical energy. In passing, we would observe that so high a voltage has never been employed before in actual practice, but we are prepared to admit that, under some conditions, such a voltage would be possible.

From the meagre details of the scheme available to the public, we gather that the cables are to be suspended from steel towers placed 1,000 ft. apart, until the overhead line reaches the outskirts of Johannesburg. There is no information given as to what the cost of such a transmission line will be, but it is clear that the promoters consider it will be very heavy, and no doubt due provision has been made for this in the six million pounds sterling which the promoters propose to spend.

The experts make much of what they term "Continuity of service," and all engineers are agreed that the success of any scheme would absolutely depend on giving a continuous supply, but to guard against the possibility of breakdown of the line, the engineers suggest what appear to us to be most extraordinary precautions, involving nothing less than the employment of a steam reserve station on the Rand itself, coupled with a system of hydraulic accumulation of power. If we read the scheme aright, the idea is that at times of low load, surplus energy is employed in raising water to a position where it is conserved, and where it is instantly available for the reproduction of electric power at such times as may be required. It is apparent, however, that this accumulation of energy is designed not only to provide for sudden demands on the works, and to equalise the load, but is intended also for use in case of the interruption of the current on the main transmission line. In brief, the scheme contemplates the carrying out of very expensive hydraulic works at Victoria

Falls, a transmission line over 600 or 700 miles of desert, a special hydraulic accumulator system near Johannesburg, and a steam reserve station on the Rand.

But surely there is unnecessary redundancy somewhere. If the accumulator is capable of meeting sudden demands and of providing against breakdown, what is to be the real function of the steam station on the Rand? Moreover, this reserve station, which we are told is to be erected as an additional safeguard, is to be of 20,000 H.P. capacity, that is, nearly half the total capacity of the large power house at Victoria Falls. We may take it that the promoters of the scheme would not put down plant of 20,000 H.P. if they did not consider that they would need to call upon it on many occasions; otherwise, we do not see how they are to provide for the interest on the plant. Considering that the scheme has been most carefully elaborated, we are surprised to find such a distinct flaw in it as this. Besides, the whole object of going to Victoria Falls, as Mr. Fox tells us in the *Daily Telegraph*, is that water costs nothing, and, therefore, "in the matter of coal, the saving must be very great."

It is not difficult, however, to show the cost of building a steam station on the Rand. Taking the present price of plant it can be assumed that a station of 50,000 H.P., which, for the sake of argument, we are keeping distinct from the 20,000-H.P. station, could be built, inclusive of the whole plant, for the sum of £700,000. The average figures put forward before the House of Commons Committee on the London power schemes were from £10 to £14 per kilowatt, and, judged by this standard, the figure we have given is very much over-estimating what would be the actual cost. But if a 50,000-H.P. plant could be erected on the Rand for the sum of £700,000, why go 700 miles and spend six millions? The promoters of this colossal enterprise state that they would be able to secure a certain amount of custom along the line of route, but it is obvious that their chief desire is to carry the whole of their power to the Rand, and it is on this basis only that the merits of the scheme can be considered.

The possibilities of power supply on the Rand are made much of by the designers of this great scheme, and it is claimed that a load factor of 66 per cent. would be obtained. This is probably twice as good as the best load factor obtained in this country; but surely such a splendid load factor must also show a steam-operated station at its best; for, after all, it is not claimed that fuel is expensive on the Rand, and we doubt whether the cost in any part exceeds 10s. per ton.

It is only necessary to refer to some of the electricity works costs, which we have published from time to time, to see that given a good load factor the cost of fuel per unit comes out remarkably low. But supposing there were a great saving to be effected between a free water supply at Victoria Falls and steam-driven power at the Rand, we have shown that the difference in capital expenditure would be roughly five million pounds, and the interest on this sum at 4 per cent. would be £200,000 per annum. Do the engineers and promoters seriously consider that for this enormous interest they are going materially to reduce the cost of electricity? We think not. It appears to us that there must be some other object in this special booming of the Victoria Falls. We have already said that the engineering details provided in the special articles in the Press are very meagre, but, such as they are, we have shown that, from a commercial point of view, there is not the smallest argument to be adduced in favour of the Victoria Falls scheme. We will, however, admit that the Victoria Falls scheme, as put forward in the Press, may appeal to the imagination of the British shareholder, and the manager of the British South Africa Co., in his interview in the *Daily Telegraph*, apparently is of the same opinion, because he states that no one with a spark of imagination could fail to be enthralled if he allows his mind to dwell upon the fascinating possibilities of this great enterprise. It would certainly need more than a spark of imagination to be enthralled with the prospects of profits from this undertaking, and it is just because we think the possibilities of a dividend from such a scheme are so absolutely remote, that we sincerely trust that if an attempt is made to exploit a company with such objects in view, the public will take warning against finding the necessary capital. There are some shrewd men concerned in this scheme, and they know, without our telling them, that the proposition to transmit electricity from Victoria Falls is absurd. Moreover, as they propose to erect their large station on the Rand, we believe they would drop the transmission system without the least hesitation; but in the meantime, they are quite ready to take any advantages that may accrue from advertising the Victoria Falls.

It is necessary to say a word in regard to another point raised by the *Daily Telegraph*. We are told that the initial work is to be carried out by the Allgemeine Elektricitäts Gesellschaft, of Berlin. The explanation advanced on this point is that no British firm has the requisite resources to undertake the work unaided; but has the British South Africa Co. ever approached a British firm, or combination of firms, to see whether the work could not be undertaken? It has, as we know, become the fashion in certain quarters to depreciate the productions of British electrical manufacturers, but it is a well-known fact among electrical engineers that even with the magnificent resources reputed to be possessed by the German firms, their work is in no way superior to British.

We are further told that the banking firms of Germany are more ready to give assistance to their industrial enterprises than are those of Great Britain. If this be the case as regards the Victoria Falls scheme, then probably there will be no necessity to appeal to the British investor, and, as it is stated that the money necessary to pay for the contract made with the Allgemeine Elektricitäts Gesellschaft will be found in Germany, it seems rather a pity that the rest of it cannot be found there.

It may be, however, we are assuming that attempts will be made to raise money for this scheme in London, and in this respect we may be wrong. It should be noted that in its anxiety to support home manufactures as far as possible, the British South Africa Co. has bound the contractors to purchase in Great Britain *whatever articles they are unable to manufacture themselves*. We attach no importance whatever to such a statement, and it is not likely that there will be much work which, under such an arrangement, will come to this country.

Sufficient has been said to demonstrate the unsoundness of the scheme, and we cannot help thinking that, stripped of its journalistic trimmings, it is nothing more than an attempt by a group of German financiers and a British Land Exploiting Co. to sufficiently interest the British public in their scheme that in due season they may be induced to give it that financial support, without which even German enterprise is powerless.

LICENCES TO WORK PATENTS.

[BY A LEGAL CONTRIBUTOR.]

A QUESTION of considerable interest sometimes arises in relation to the law of letters patent, namely, what rights are conferred upon those who make a patented article under licence from the patentee and those who purchase patented articles? May a licensee not only make and sell, but improve upon the article in question? May the purchaser of a patented article alter it, put his own name upon it, or export it to other countries without the leave or licence of the patentee?

A case which was heard some time ago in the Chancery Division, before Mr. Justice Buckley, throws some light upon these important questions. In that case the Baelische Anilin und Soda Fabrik in July, 1888, granted a licence to the Society for Chemical Industry in respect of a patent for the sale and manufacture of certain dyes. Dyes made by the plaintiffs were packed and sold in tins bearing the following label:—"Important notice: Purchasers of this dye are not licensed to resell it except in the unopened original package in an unchanged condition and with the labels thereon intact; nor are any persons other than purchasers of such unopened original package licensed to use the dye contained therein. All other sales or use are infringements. Agents and dealers are not empowered to vary this licence in any way. . . . . The resale and importation of our patented articles in the United States of America is prohibited."

Mr. Justice Buckley declared the law to be as follows:—If the patentee sells the patented article and the purchaser uses it he does

not infringe, because the law implies a licence by the patentee to the purchaser to sell or deal with the article as he pleases, unless at the time of the purchase the patentee imposed a condition. If a purchaser buys from a licensee to whose licence the patentee has attached conditions, nothing turns (so far as licence as distinguished from estoppel is concerned) on the question whether the purchaser knew of the conditions or not. If a person innocently uses a patented invention, not knowing that there is a patent, he is none the less an infringer, and if he buys from a licensee, not knowing that there are limits to the licence, he is equally an infringer. In this case, however, the patentee may be estopped from suing in certain circumstances, as, for instance, if he has acted in such a way as to lead the purchaser to suppose that the licence is not limited. As a matter of fact, the learned judge held that, in the present case, a purchaser from the society was not bound by any conditions other than those printed on the label.

There is no limit to the number of persons to whom a patentee may grant the authority of his licence. Where, however, he grants an exclusive licence, no further licence can, it would seem, be granted by him for the same invention in respect of the same district without the breach of an implied contract with the exclusive licensee not to make such grant (Heap *v.* Hartley, 42 Ch. D. 470).

A patent licence may be a bare licence, in which case, whether exclusive or not, it is revocable at will, or it may be a licence coupled with an interest in the invention to which it relates. If coupled with an interest, the Court will construe it as irrevocable and binding on both parties for the full period for which it purports to be granted; though the failure to observe the conditions incorporated in it may entitle the licensor to treat the licence as forfeited and sue the licensee as an infringer (Ward *v.* Livesey, 5 R P.C. 102).

It is clear that if a patentee sells the patented article, the purchaser from him has an implied right to use the article as he pleases, unless at the time of the sale he is informed that there are restrictions on the user. If the law were otherwise, the whole object of the licence would be defeated (Thomas *v.* Hunt, 17 C.B.N.S., 183). Although every sale of a patented article by the patentee licenses, by implication, the use or re-sale of that article in the hands of any subsequent purchaser, it has been held that this implied licence may be rebutted by express notice to the buyer, or a less extensive licence. Thus in the Incandescent Gas Light Co. *v.* Broyden (16 R.P.C. 179) the Court held that the patentees could limit the licence by notice that on selling they only authorised the use or re-sale of their invention in conjunction with another article also supplied by them; and re-sale or user without that adjunct was held to be an infringement. A licensee may not sue in respect of infringements of the patent; any proceedings must be taken by or in the name of the patentee. But an exclusive licensee is apparently entitled for this purpose to use the name of the patentee.

THE CONTINENTAL ELECTRICAL ENGINEERING INDUSTRY.

It was recently reported in Austrian circles that endeavours were being made to bring about a friendly arrangement between the rival owners of Wolfram lamp patents. Whether an understanding has been reached is not apparent, but it would seem that some such movement is in progress from the formation of the International Wolfram Lamp Co. under the auspices of the Commercial Bank of Buda-Pesth. In Germany the syndicate of cable-makers will nominally expire next June, and speculation is rife as to whether the combination will be prolonged. Negotiations on the subject are proceeding, but they are proving to be somewhat difficult.

German Undertakings.

The directors of the Siemens & Halske Co. have approved the accounts for 1905-6 which allow of the payment of a dividend of 10 per cent. as compared with 9 per cent. in the preceding year. The board of the Siemens-Schuckert Works Co., of which the former company holds £2,002,500 out of the total capital of £4,500,000, announce that after making abundant provision for depreciation and reserve funds, it will be possible to distribute profits which represent a considerable advance over those which were divided for 1904-5.

The report of the Allgemeine Elektrizitats Gesellschaft for 1905-6 states that the increase in the share capital to £5,000,000 was carried into effect during the year, and the premium realised allowed of a considerable addition being made to the ordinary reserve fund. Business was extremely brisk and the turnover was larger than in any previous period, notwithstanding the interruption in working caused by the strike in October of last year. The sale prices suffered, however, owing to intense competition, both inland and abroad, and the increase in wages and the cost of raw materials. The financial position is briefly as undernoted:—

	1905-6.	1904-5.
Ordinary share capital ...	£5,000,000	£4,300,000
Net profits	644,447	616,576
Dividend, per cent.	11	10

The dividend is at the rate of 11 per cent. on £4,300,000 and at 5½ per cent. on the remaining £700,000 share capital. During the year the company delivered 37,424 machines, motors and transformers, of a total of 602,241 kw., as compared with 27,791 and 476,761 kw. in the preceding year respectively. The sale of turbines again made favourable progress, and the value of the orders at the end of the year was twice that obtaining at the beginning. The number supplied was 141 steam turbines, which are given in the report as of 72,475 kw., as against 90 of 29,550 kw. in 1904-5. The Oberspree cable factory was very well employed, and the successful laying of an underground cable in England for a working pressure of 20,000 volts should open a new field for the use of high pressure cables. In the case of carbon filament lamps the output was 2,000,000 in excess of the previous year. The attempts made to reduce the consumption of energy were successful, and lamps were now made in large quantities for 2½ watts per normal candle, and having the same life as the less economical lamps. The Arons vapour lamp made satisfactory progress, and as reliable ignition and life had been obtained the lamps were now being placed on the market. The Nernst lamp had been sold to the extent of 7,500,000, and a new and very cheap burner was in prospect in the near future. In connection with this branch attention was paid to the utilisation of rare earths for obtaining a metal filament lamp. The total number of employés in the various works was 33,906 as compared with 30,336 in 1904-5. The report proceeds to state that 61 central stations (or extensions) of 86,640 h.p. were completed during the year, exclusive of the large plant for the Berlin electricity works, and 68 stations of 98,450 h.p. were in course of construction. As to electric traction on main lines, the directors were devoting increasing attention to this question as it was expected to be a remunerative branch. In conjunction with an allied firm the company had secured the contract for the permanent way for the Hamburg State high level and underground railways amounting to over £2,000,000, although the contracts for the rolling stock and electrical equipment had yet to be placed. The railway undertakings in which the company is interested developed satisfactorily during the year. In conclusion, the report observes that the orders taken over in the new year afforded full employment for the workshops, that the results in the first few months were also satisfactory, and that the future is looked forward to with confidence so long as development is not arrested by economic, financial and political events.

The shareholders in the Rheydt Cable Works (Kabelwerk Rheydt) Co, of Rheydt, recently approved the report and accounts for 1905-6. It was stated in the report that all departments were well employed during the year, although no information was given in regard to the movements of prices and sales. The accounts presented showed net profits amounting to £19,950 as compared with £20,077 in 1904-5, and a dividend has been declared at the rate of 15 per cent., being the same rate as in the preceding year, when the capital participating reached £75,000. However, for the last year the capital totals £112,500, but the increase of £37,500 is only entitled to the dividend for six months out of the year. A fresh augmentation of the share capital to the extent of £75,000 is now being made, and this will bring the total up to £187,500. The additional capital is needed partly for working capital and partly for the purpose of defraying the cost of copper and bronze rolling mills which will be started next April.

The undertaking of the German electricity works of Garbe, Lahmeyer & Co., of Aix-la-Chapelle, experienced a material improvement in 1905-6, seeing that the net profits reached £11,911 as compared with £3,988 in the preceding year and £179 in 1903-4. After placing £3,750 to the reserve fund the balance has allowed of the payment of a dividend at the rate of 4 per cent. for the year as contrasted with no distribution whatever in the two previous years. It was stated at the recent general meeting that the prospects for the current year were favourable, that the orders were satisfactory, and that it had been possible to make an increase in prices.

The Gesellschaft für Elektrizitats Anlagen (Electrical Investment Co.), of Berlin, owns several electric supply works, and is also financially interested in others. According to the directors' report for 1905-6, the company's own undertakings made satisfactory progress, whilst the results from the other undertakings were of a varied nature. The final outcome for the year was a net yield of £17,373, as compared with £15,192 in 1904-5. It is proposed to pay a dividend at the rate of 6 per cent. on the preference capital of £250,000, being the same rate as in the preceding year, but the holders of the ordinary share capital of £100,000 will again not receive any distribution.

The report of the Helios Electricity Co., of Cologne, which is in process of liquidation, states that the winding-up of the manufacturing and sales business was almost completed in 1905-6, and the reserves provided for this purpose had so far proved to be sufficient without causing any alteration in the debit balance during the year. The final payment for the Ehrenfeld Works, which were sold to the Cologne Industry Works Co., was received, and the option in regard to the holding of shares in the Union de Tramways, of Brussels, was exercised. By these means it was possible to pay 8½ per cent. to the mortgage creditors at the end of the year. The balance of loss for the year reached £4,250, but as this was covered out of the reserves, the deficit of £389,200 brought forward from the preceding year remained unchanged. The report gives particulars of the electricity works and tramways in which the company is interested. The loan debt amounts to £760,000 on a share capital of £419,500.

Belgian and Other Works.

The Compagnie Internationale d'Electricité, of Liége, which has an issued ordinary share capital of £251,080, and obligations amounting to £68,000, realised gross profits of £37,630 in the year 1905-6, and net profits of £21,126. The latter sum has permitted of the extinction of the loss of £10,000 brought forward from previous years, whilst the balance has been devoted to the purpose of depreciation. In the course of

the directors' report, it is stated that the order book was well filled during the year, the concluding months showing an increase, which became accentuated at the beginning of the present financial year. The company's model installations for coal mines resulted in the receipt of important orders, and several large metallurgical works, after the adoption of initial plant, called upon the company to complete the equipment of their rolling mills. The Paris branch materially increased its volume of business, and the London branch continued to cause the company's manufactures to be appreciated in various regions, especially in the Transvaal, Japan and New Zealand. At the time of the issue of the report, the company was engaged upon the erection of an important installation in a Welsh coal mine. The directors proceeded to refer to the increased protection enforced by Russia, Germany, Spain and France in contradistinction to the open frontiers of Belgium, and they urged that the Government should investigate the situation and take steps for the adequate protection of the company's interests. In conclusion, the report mentioned the train lighting system of Hoest-Pieper, which had resulted in negotiations with several railway administrations, and the "Automixte" method of traction, of which the Belgian railways were to make a trial with the locomotive shown at the Milan Exhibition.

The report of the Maschinenfabrik Oerlikon (Oerlikon Machine Works) for 1905-6 states that the workshops were fully employed, and the demand continued brisk. As a result of the experience gained in recent years, the majority of the firms engaged in the constructional branch of electrical engineering were induced to endeavour to obviate the unsound competition which has led to underselling, and less cutting was found than in previous years. The arrangements made between the German and Swiss firms for increasing prices were, however, not able to exercise any material influence upon the company's trading for the year, as the orders affected were only completed about the end of the 12 months. The financial position is as follows:—

	1905-6.	1904-5.
Ordinary share capital	£320,000	£320,000
Obligations	160,000	160,000
Gross profits	72,846	—
Net profits	618	156

The directors state that the experiments with electric traction on the Seebach-Wettingen section of the Swiss Federal Railways confirmed the belief that high working pressures could be employed with safety, and that the single-phase alternating current motor justified the expectations placed upon it. At present the company was carrying out an order for the electrical equipment of the railway in the Maggia Valley on that system, and this would, therefore, be the first railway of its kind in Switzerland. During the year the company received a number of orders for steam turbines and delivered 69 crane and other lifting plants, and 716 transformers and 3,395 dynamos, these representing a large increase over the preceding 12 months. It is added that the year's trading would have allowed of the payment of a dividend, but it was decided to abstain from any distribution in the interest of strengthening the financial position of the undertaking.

The United Electricity Co. (Vereinigte Elektrizitats Gesellschaft), of Vienna, after passing the dividend for a period of four years, has succeeded in making a distribution for 1905-6. It is pointed out in the report that a regrettable disproportion between the prices of raw materials and manufactures arose in consequence of the rise in the prices of the former, and that this became aggravated by severe competition. After deducting working expenses and 122,730 kronen for depreciation, as compared with 209,970 kronen in 1904-5, the accounts show an available surplus of 470,089 kronen, as contrasted with 98,200 kronen in the preceding year. The surplus has allowed of the payment of a dividend at the rate of 5 per cent. The company some time ago secured the contract for the establishment of electricity works at Tirga-Jiu, in Roumania, and for the electric railway between Mandelpass and Dermulo.

A SIMPLE DEVICE FOR MEASURING DEFLECTIONS.*

By B. OSGOOD PEIRCE.

For a good many years we have used in the Jefferson Laboratory, to determine the deflections of mirror galvanometers and other similar instruments, a simple form of tubeless telescope, which, at first intended for students only, has proved in its way very convenient, and has been adopted for some standard fixed instruments, because it is not easily put out of adjustment after it has once been properly set up, and because the scale image is so large and clear that a prolonged use of the device does not involve the eye strain which most reading telescopes would cause.

In front of the plane mirror M of the galvanometer, instead of the usual cover glass, is placed (fig. 1) a convex lens, A, of focal length equal to the desired scale distance. This lens need not be achromatic; a spectacle lens is quite good enough. At a distance in front of A equal to its focal length is placed a horizontal scale, S, mounted on a thin strip of wood at least twice as wide as the scale itself. Through the middle of this strip, above the scale, is bored a round hole, H, rather more than 20 millimetres in diameter; just behind the scale is stretched a fine vertical wire or silk fibre, to serve as a cross-hair. Behind H, and at a distance suited to its focal length, and to the eye of the observer, is placed another spectacle lens, B, to serve as an eye-piece. The centre of H should lie approximately in the common axis of A and B. A peep-hole P on this same line is placed at such a distance behind B—which may conveniently have a focal length of 12 or 15 centimetres—that B's aperture shall appear *wholly filled* with a large, clear, uncoloured image of the

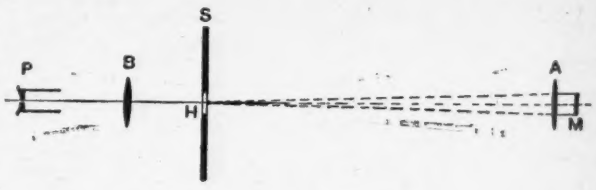


Fig. 1.—Plan.

scale, with the wire running vertically across it. The proper distance between A and S is determined by making the parallax of the wire across the lines of the scale, when the eye is moved sideways across the peep-hole, to disappear; when this distance has once been found, the scale is firmly clamped in position. The distances between S and B and between B and P may be adjusted by every person to please himself, though it is usually possible to fasten P securely in a suitable position, and to move B only to fit the eyes of different observers. It is important to notice that if the distance between the eye lens B and the peep-hole P is not properly chosen, only a small round portion of the image of the scale will be seen, not nearly large enough to fill the aperture of B, and this will appear to move about in a distressing manner when the eye at the peep-hole is moved slightly. When the simple adjustments have been properly made, however, the eye need not be pressed close to the peep-hole, for the deflections of the galvanometer can be accurately and easily read whether the eye is 1 in. or 4 or 5 in. behind P. It is not necessary to close the unused eye, for the field should be extremely bright and clear. The observer is, of course, looking at a life-size image of the scale at a distance PH from the peep-hole, and it is easy to get any desirable magnification of this image by a proper choice of the eye lens. Ordinary astigmatism on the part of the observer's eye can be partially corrected by a suitable spectacle lens at B. One slight drawback to the use of this reading device, where space is limited, is the fact that the eye will generally need to be 25 or 30 centimetres behind the scale. When it is desirable to do so, the eye-lens, B, may be mounted in a tube which slips over the tube which carries the peep-hole.

* *Proceedings* of the American Academy of Arts and Sciences, July, 1906.

LEGAL.

The Llanrwst Electricity Co.—Marriott *v.* Janes.

This action was before Mr. Justice Neville in the Chancery Division of the High Court of Justice on Tuesday (December 4th) as a short cause. Counsel for the plaintiff said this was a motion for judgment in a debenture-holder's action. Negotiations had been pending for the purchase outright of plaintiff's interest in the mortgages, but these negotiations had come to nothing, and it was necessary to proceed to judgment. There were 44 first mortgage debentures of £100 each, and a receiver had been appointed.

Mr. Justice Neville made a declaration of charge, and directed the usual accounts and inquiries to be taken.

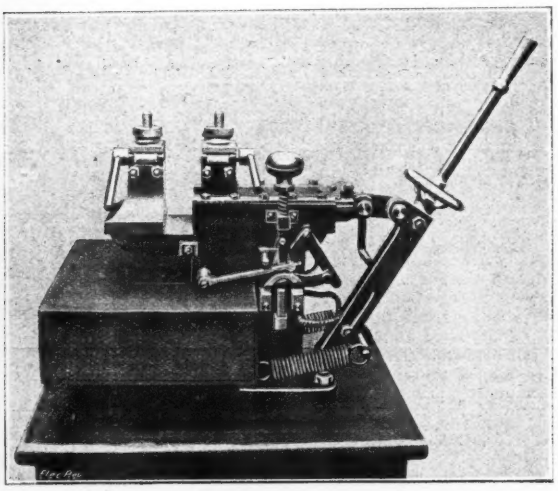
NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

The Prescot Electric Welder.

Messrs. British Insulated and Helsby Cables, Ltd., in a pamphlet just issued give a detailed description of new electric welders which they are making. They are specially designed for dealing with metal of comparatively small sections, and will weld wires and rods of the smallest sizes up to rods of the following maxima:—Iron or steel, $\frac{3}{4}$ in. diameter; brass, $\frac{9}{16}$ in. diameter; copper, $\frac{5}{8}$ in. diameter. Bars and strips of any shape or section can also be welded provided the sectional area does not materially exceed that of the equivalent areas for rods just mentioned. In their works at Prescot the makers regularly roll considerably more than 200 tons of copper per week, the bulk of this being drawn into wire of various sizes from $\frac{5}{8}$ in. diameter downwards, or rolled and drawn into strips of various sections for electrical purposes, and a very large number of welds have to be made in the different stages

of manufacture. Many welds have also to be made in the iron and steel armouring for their cables, and in their other manufacturing processes. The company is therefore fully experienced in the use and behaviour of electric welders. A machine is placed at every point in the works where required, instead of the work being brought to the machine, yet 22 welders amply serve for all requirements, owing to the rate of operation. These machines are supplied with current by one 15-kw. transformer (100 volts, 50 cycles).

The Prescot welder appears to be on the Thomson system, consisting of a transformer, the secondary coil of which consists of a massive single convolution terminating externally in two clamps which grip the two rods required to be welded. The (say) 100-volt current supplied to the primary coil is transformed to a very low-pressure current of great strength in the secondary coil, the current so produced flowing across the junction of the two pieces to be welded, whose ends are kept in contact under moderate pressure, and the desired heat is developed at the point of contact.



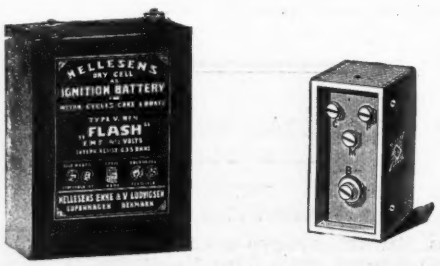
The Prescot No. 6 Electric Welder

For regulating the pressure between the ends of the rods to suit varying sizes and plasticity, a device is provided which gives the correct welding temperature. The heat is applied at the exact spot required, and the joint is trimmed down by filing or by an emery wheel.

In the publication to which we have already referred, the makers give a description in detail of the full equipment as supplied by them. We illustrate the No. 6 welder, which weighs 320 lb. and is suitable for welding copper and brass, from ·064 in. diameter to ·400 in. diameter, or iron and steel from ·064 in. to ·750 in. diameter. In ·400 in. copper wire, 60 welds can be made in one hour. The power required during the welding operation is stated as about 8 h.p., lasting seven seconds for one weld, and the cost of energy at 1d. per unit is given at less than 1s. 6d. for 1,000 welds. Smaller equipments, No. 1 and No. 3, weighing 40 lb. and 56 lb. respectively, for small wires, are also illustrated in the catalogue.

"H. H." Dry Battery Ignition.

In his newly-issued catalogue of automobile accessories, Mr. A. H. Hunt, of 115-117, Cannon Street, E.C., shows suitable apparatus for working in conjunction with the "Hellesen" dry cell ignition battery. This apparatus, while essential to obtain the



Battery and Coil for "H. H." Ignition.

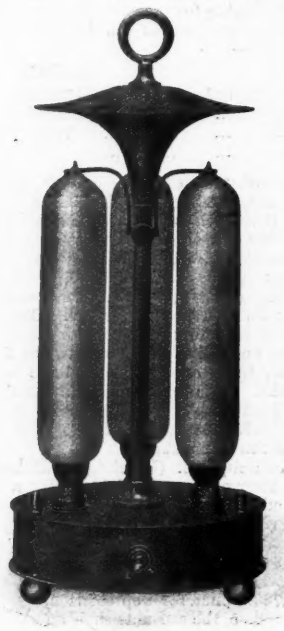
best results from dry batteries, can also be used with accumulators, and is claimed to enable a greater mileage per charge to be obtained. We are informed that since the issue of his dry battery ignition publication in July last, the use of the "Hellesen" dry ignition battery has considerably increased, and this fact has led to the placing upon the market of a complete system of dry battery ignition, by means of which the mileage is increased, and troubles of burnt contacts, &c., are claimed to be eliminated. Knowing the capabilities of the "Hellesen" dry battery, both as regards capacity and rate of discharge, Mr. Hunt has produced a coil and contact breaker specially suitable for it. It is stated that the "H. H." (Hellesen-Hunt) combination when fitted to a motor cycle consumes about ½ ampere, and gives a spark ⅜ in. long. By the aid of low current consumption a single-cylinder cycle fitted with the "H. H." system with a Hellesen "Flash" battery would be able to run for a mileage of from 1,500 to 3,000, depending upon the care taken in the use of the battery. To obtain still greater mileage, two batteries can be carried and coupled to the usual two-way switch so that they can be changed over periodically, say, every 20 or 30 miles, thus allowing one battery to rest or recuperate while the other is in use.

The "H. H." system is equally applicable to cars, and suitable batteries, coils and contact-breakers have been designed and are stocked.

In the figures we show a "Flash" combined 4½-volt battery, and a plain wood case coil for a single-cylinder motor cycle.

"Cruet" Radiators.

In our last issue, we mentioned under "Trade Announcements" that the Birmingham Guild of Handicraft, Ltd., who have already established for themselves a very creditable reputation for the production of electric light fittings in artistic metal-work, had amalgamated with the business of Messrs. Gittins Craftsmen, Ltd. This amalgamation has naturally led to a considerable increase in the staff employed, and in the general operations of the company. Last week we had the opportunity of an interesting run through the various departments of the company at their works in Great Charles Street, Birmingham, and noted in doing so that the finishing



A Birmingham "Cruet" Radiator.

touches were being put to a new polishing department that has just been erected. The Birmingham Guild are making a special feature of electric radiator design, and a perusal of their new list shows that they have not been backward in the production of some very acceptable designs in this direction. For use in better class residences they turn out some good things, and they also pay attention to the needs of public buildings in this matter of electric heating. In addition to a number of "Dowsing" patterns, the company are making a good line of "Cruet" pattern radiators in brass, and in brass and copper. One of these we show in the accompanying illustration. Not long ago the company executed a large order for electric radiators for the Metropolitan Railway.

Smoking Concert.—A smoking concert was held by some 60 members of the staff of the Adams Manufacturing Co, Ltd., at the Swan Hotel, Bedford, on Thursday last week. The programme was made up principally of contributions by members of the staff. The toast, "The Adams Manufacturing Co., Ltd," was proposed by Mr. Reg. Smith and seconded by Mr. Curtis. Mr. Adams, in response, thanked the staff for the accord and energy with which they had worked together during the past year. A vote of thanks to Mr. Adams, the chairman, was passed with great cordiality.

Reduction of Capital.—Northallerton Electric Light and Power Co., Ltd.—A petition for reducing the capital of this company from £10,000 to £6,500 by cancelling capital which has been lost or is unrepresented by available assets, is to be heard in London on Tuesday next, December 11th.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Tramcar Brakes.

With reference to the recent discussions, reports, correspondence, &c., in your valuable paper anent tramcar brakes, permit me to say a few words for the benefit of that much befooled class, viz., inventors.

In your leading article, November 2nd, 1906, you were good enough to make several useful and entirely admirable suggestions as to the type of brake which ought to exist.

To such an extent, in fact, did your remarks impress the writer, that he forthwith designed a brake which is *meant* to be driver proof and independent of all other brakes. Having nearly completed this labour of love, it now occurs to me that if my idea were made public to-morrow, nobody would really want it (except for nothing). Now supposing—

1. That the cost of production of above-mentioned brake was no greater than that of the ordinary handbrake.

2. That said brake operated as designed.

I am still absolutely certain that none of our manufacturers would have anything to do with the latter.

Now, I do not wish to malign British manufacturers; far from that. They are a class of unemotional and cautious persons who have trouble enough to make ends meet in these days of competition.

In the present instance, however, their position, if I do not mistake them, is simply this: "That tramcars, &c., except in a few special cases, have quite sufficient braking power already, and the addition or substitution of further braking arrangements for those already in existence would merely cause unnecessary complications, and add considerably to the cost of maintenance. Doubtless, an accident occasionally occurs, such as the recent deplorable disaster, and an outcry is raised by the public, and the Board of Trade duly make a searching examination and criticise this or that severely; but, after all, we must leave something to 'human' intelligence in the driver."

Now, therefore, let inventors beware before wasting time and substance in the vain hope of supplying a *felt* want. Let them consider how fading and transient are the feelings on which their hopes depend.

Convalescent.

In reference to letters appearing in Electrical Review "Correspondence" column *re* tramcar brakes, it seems to me that all the present brakes in use appear to be defective in some way.

My opinion is that the best brake is undoubtedly the Westinghouse compressed air type. Of course, against the adoption of this brake will be urged the point of expense and extra gear on each car; but as the receipts depend upon the confidence of the public to a very large extent, I think the extra expense warranted, as the large number of serious accidents constantly occurring are bound to have a demoralising effect on the passenger, as well as on the unoffending pedestrian.

I think that two brakes on a car are ample, and with reliable gear the use of one only—namely, the compressed air type, to be used on all occasions. A multiplicity of brakes only adds to the confusion and hesitation of the driver, which is bound to be fatal; in the case of failure of compressed air, the reversal of motors or "run back" controller may be resorted to.

Brakite.

Advertising in Electricity Works Pamphlets.

It has for some time appeared to me that there is room for an association of the kind suggested by "Publicity Department Manager" and Mr. Robinson. I believe that such a society—of which we have precedent in America—would be in every way a benefit to its members and to the work they are engaged upon. As it appears that some active steps may be taken in the matter through your kind agency, I think it is desirable to put forward at once a claim for those engaged in electricity supply development. As you are aware, the numbers of such are increasing daily, and as their interests in practically all respects are identical with those of the manufacturers, I believe the more intimate relationship into which the two sides would be brought would result in mutual benefit. If a committee be formed to consider the question, I would suggest that two or three of those responsible for electricity supply development work on a large scale be asked to attend; and in the event of the movement taking definite shape, I would further suggest that supply men should be allotted their proportionate share of control. The success—financial or otherwise—of any society depends upon the length of its membership roll, and this might be considerably increased by the admission (perhaps in some special degree akin to the associateship of the institution) of canvassers and other qualified assistants. Many are enthusiasts in their work, and I believe would join a body which brought them into personal contact with others and afforded them opportunities of extending their knowledge and bettering their position.

The whole question calls for careful consideration, and many difficulties would, no doubt, be met with. I think, however, it might be approached, for of the value of a society of this description there can surely be little doubt.

Electricity Supply.

[Our correspondent's suggestion will be borne in mind.—Eds. E.R.]

Commutator Insulation Defects.

Mr. Longridge, in my opinion, is quite correct in his remarks that micanite is unsuitable for commutator segments.

I have constantly had trouble with commutators insulated with these segments, and with a long experience of its use and defects. I have always condemned it, preferring to use pure mica, which, though more costly, is absolutely reliable.

As for the use of silicate of soda and powdered mica which Mr. Turner recommends, this is fairly satisfactory, but I find that "Lithage mixed with glycerine to a thick paste is a very successful remedy for these defects, providing it is baked into the commutator at the correct drying heat," but, as Mr. Vickery says, there is both good and bad micanite.

Harry H. Sheppard.

Sheffield, *December 3rd*, 1906.

Commutator Lubrication.

I should like to know if any of your readers have had any trouble with the lubrication of commutators, carbon brushes being used. My experience is, that it is better not to use lubricants of any description. I find, that, to clean the commutator occasionally with mineral oil, taking care to rub every trace off and not allowing it to get to the faces of the brushes, is the best way. Some engineers find paraffin wax a good lubricant, probably it is on very large generators, but on machines of, say, 200 to 300 KW. capacity, I very much doubt it. I have no doubt that it would interest a great many other engineers to know a few of your readers' experiences.

Electra.

December 3rd, 1906.

Prepayment Meters.

Having seen the letter published in the Electrical Review of November 30th, over the initials "A. J. P.," we shall be very glad to furnish your correspondent with the information which he requires, as to where he may find electric light installations on the prepayment system.

As we are manufacturers of slot meters, and have during the last eight or nine years sent out somewhere about 10,000 instruments, we shall no doubt be able to supply the information desired.

The Rochdale Electric Co., Ltd.,
William D. Watson.

Rochdale, *December 3rd*, 1906.

Rail Corrugation.

I am pleased to see that my pet theory has now been advanced by Mr. Boult, and also by Mr. Bowker, for I have long held the opinion that the rolling mill is the source of rail trouble. The irregularities of the web noted by Mr. Harvey are well known to rolling mill engineers who, by the way, will not be induced to express an opinion either verbally, or through the "Correspondence" columns in the technical Press. I have myself seen quite regular corrugations which are clearly visible, especially after the metal has passed through the roughing rolls, and before it has been through the finishing rolls. These corrugations are in the trade known as "teeth marks" for they clearly indicate that there is too much play in the pinions driving the rolls, and I have often seen steel bars on the scrap heap owing to these corrugations, which entirely disappear after the bearings and pinions have been adjusted.

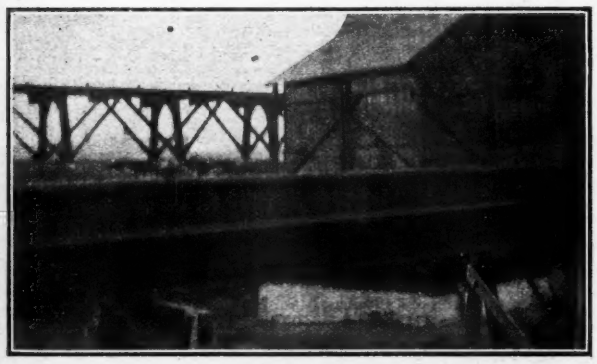
I can, therefore, endorse the opinion of Mr. Bowker that prolonged rolling at low temperatures will improve the rails; and if it were possible to finally anneal them, I believe rail troubles would be considerably minimised.

Much has been said in the tramway journals on the question of foundations and rail joints affecting corrugation, but having had experience of corrugations on rails laid on concrete foundations, on longitudinal sleepers, with and without anchor joints, and also on rails with splayed or mitred joints and welded joints—up and down track—and also on curves, but having never found a trace of corrugation on cast-steel rails on the straight or curves after six years' severe service, I can only come to the conclusion that the rolls are the original source of rail trouble.

H. E. Yerbury,
Chief Electrical Engineer.

Sheffield, *December 3rd*, 1906.

The accompanying illustration is reproduced from the photograph kindly sent us by Mr. L. Harvey, in support of his interesting theory. It will be seen that the web of the rail shows a series of corrugations, apparently due to unequal contraction of the web and of the head and foot of the rail.



The photograph has not been "faked" in any way; the half-tone reproduction shows the corrugations rather more plainly than the original in the case of the upper rail, and rather less plainly on the lower rail.—Eds. E.R.

Suction Gas Power.

While it is always necessary to be on our guard against competitors with such plausible arguments, estimates and figures as those put forward by the exponents of suction gas, I really think electricity supply managers are making too much of a bogy of this particular form of competition. When these figures are put forward (and we have an example in Mr. Campbell's letter in your issue of the 30th ult.) some misrepresentation or unequal comparison always shows itself upon examination.

For instance, imagine the utter absurdity of comparing the costs of a *lighting* supply steam plant and a *power* supply gas plant, and who would use coal at 16s. 2d. per ton nowadays for steam plants? The wages and repairs items for steam are ridiculous, that is, if the plant is any criterion of steam plants generally. If not, the figures should not have been used.

If you can generate electricity by gas at ½d. per unit, why would manufacturers pay us, as they do in my district, ¾d. and 1d. per unit for electricity? In one case a comparatively new gas plant was scrapped in favour of electricity, and in several others, after very careful comparisons, by the directors of the concerns. Of steam, gas and electricity the latter has been decided upon on *price*, and, although mine is essentially a manufacturing district, I believe I can say that not a single gas plant has been put in any factory during the past twelve months, the period of my connection with the electricity supply undertaking.

I do not indicate my particular sphere of operations, because I am not anxious to have my time and that of my staff wasted in contradicting the flood of suction gas literature and armies of experts which would overwhelm my power consumers.

Supply Manager.

Wiring Estimates.

In your issue November 2nd, 1906, appears a letter from "Contractor" asking for a cost book with a view to facilitating the estimating of wiring. If such a book is on the market we should be obliged for publisher's name.

Another Contractor.

[Mr. Perren Maycock issued a book of this kind some years ago; Messrs. Whittaker & Co. are the publishers.—Eds. E.R.]

Wireless Telegraphy.

The letter of Mr. Cuthbert Hall, which appears in your columns on page 865, raises the question whether there are not three distinct personalities who possess the same name.

1. There is the Mr. Cuthbert Hall who, in 1903 and 1904, signed agreements as director of the Marconi Co., with the Admiralty and with the Post Office. By the former of these agreements the Marconi Co. waived any future claim to royalty or damage against the Admiralty in respect of any apparatus not supplied by the company, save such as was included in a schedule relating exclusively to jiggers and trays of Leyden jars. By the latter agreement the company undertook to receive at its stations any messages from ships not equipped with the company's apparatus, in the event of the Government adhering to the proposed International agreement.

2. There was present at the Berlin Conference a delegate from the Kingdom of Montenegro, doubtless a distinguished officer of the Montenegrin navy, whose name was—by a singular coincidence—Cuthbert Hall. This delegate, I understand, complained at the Conference that the British delegates would not support the policy of Montenegro, but voted solidly for the policy agreed upon by the British Government before the opening of the Conference, and carried every point that they deemed vital. He also grumbled mightily at Berlin, because, as representative of Montenegro, he had no vote in the Conference.

3. There is the Mr. Cuthbert Hall who writes to you declaring that "it is incorrect to say that the Admiralty is not compelled to purchase any more apparatus from the Marconi Co., except jiggers and trays of Leyden jars;" and who, in his last paragraph but one, appears to repudiate on behalf of the Marconi Co. the plain undertaking given in the official agreement of 1904, to open its stations to messages from ships equipped with other systems, if the Government should in pursuance of the proposed International agreement require this to be done. He also asserts that the vote of any State, "even Monaco," had exactly the same weight as the British vote.

It therefore appears that Mr. Cuthbert Hall No. 3 disputes the doings of Mr. Cuthbert Hall No. 1. Mr. Cuthbert Hall No. 3 is also at variance with Mr. Cuthbert Hall No. 2 as regards the voting power of small States such as Montenegro and Monaco.

Under the circumstances, the simplest answer to Mr. Cuthbert Hall No. 3 is to leave him to fight it out with the other two claimants to the name.

Your Correspondent.

The Penetrating Properties of the Arc Light.

In answer to Mr. Bastian's letter of the 13th ult., I would ask him to direct a beam of white light through gold leaf and see if he will still "refuse to distinguish between reflected and transmitted light."

He says in his last paragraph that I admit that "air" reflects blue light best, whereas I only admit that the atmosphere does—a very different thing. According to the theory I support, it is not the air in the atmosphere, but the suspended solid or liquid particles of a size comparable to the wave length of light that reflect the blue rays best.

The points in favour of this theory may be stated as follows :—

1. It can be shown experimentally that minute solid particles suspended in a gas or liquid will reflect the blue rays and allow the less refrangible to pass.

2. It is certain that such minute particles must be present in the atmosphere, and therefore the latter ought to exhibit this effect.

3. The atmosphere does exhibit this effect as seen in the violet-blue reflected light during day and the red transmitted light at sunset.

Mr. Bastian's effusion in answer to Mr. Dow is a complete *reductio ad absurdum* of his own position. His illuminant, whose light appears white in clear air and then appears red after passing through a red-absorbing fog, is startling, but not so much so as Mr. Bastian's explanation that it is due to an excess of red rays in the illuminant. This correspondence has been drawn out to such a length that I hope I will not have to trouble you again, especially as Mr. Bastian persists in ignoring a repeated request of mine for enlightenment upon the photographic effect of distant objects. Again I appeal to him to explain. If the blue colour of distant objects is due to absorption of red rays—as he alleges, why do these distant objects appear too light in a photograph ?

Sol.

York, *December 3rd*, 1906.

I now realise that nothing I can say will shake Mr. Bastian's convictions, and therefore see no object in discussing in detail his letter in your issue of the 30th.

There are, however, two points in that letter which seem to me misleading, and I feel I must refer to them.

Mr. Bastian says that I "claim to have discovered a general law," &c. I have made no absurd claim of this kind. There is surely nothing novel in the suggestion that rays of greater wave-length penetrate the atmosphere best. This is the accepted view, and the novel suggestions are those put forward by Mr. Bastian. I freely admit that the subject requires closer study before any law can be laid down, and only feel that, while there is some strong evidence in favour of the general view, Mr. Bastian has not succeeded in bringing forward any satisfactory evidence in favour of his.

Mr. Bastian has also criticised my demonstration of the Purkinje effect before the Physical Society. I was, I need hardly say, aware that the light from a glow lamp becomes somewhat redder, as the lamp is dimmed by placing resistance in the lamp circuit.

But, so far from *increasing* the Purkinje effect, this would tend to diminish it slightly by accentuating *red* colours at weak illuminations.

For a rough demonstation, however, not much difference seems to be produced in this way, and I have often obtained the same results by dimming the lamp by other methods. The magnitude of the Purkinje effect at low illumination has really been shown over and over again, and cannot possibly be doubted.

I must also point out—what Mr. Bastian does not seem to understand—that the results bearing on the Purkinje effect quoted in my article, were not based on this purely qualitative experiment at all.

J. S. Dow.

London, N., *December 3rd*, 1906.

Inquiries.—A correspondent asks for the address of manufacturers of an electrical counting machine. Another wants a thermopile to fix on a gas bracket.

BUSINESS NOTES.

Book Notices.—*Lichtstrahlung und Beleuchtung.* By Paul Högner, Brunswick. Fried. Vieweg & Sohn. Price 3 M.—This eighth volume of the series "Elektrotechnik in Einzeldarstellungen" maintains the high standard of most of the previous volumes, and is well fitted to give a general insight into the problem of illumination from a practical point of view. The first twelve pages deal with the theoretical rules for light emission from various simple surfaces, and here the absence of any clear definition of the different units involved is a serious omission. In the following eight pages a discussion of the characteristic shapes of the polar curves for arc lamps is given and a useful table of cosine differences is included, by means of which the mean hemispherical candle-power can be estimated from the polar curve directly, without the trouble of first drawing the Rousseau curve. The question of illumination indoors and out of doors is next dealt with, and a set of tables (some of which, *e.g.*, No. XVI., are hardly sufficiently explained) is given, enabling the illumination of various points to be estimated for various lamp heights and spacings, and for ordinary and flame arc lamps of different current capacities. The photometric methods employed are not discussed or even described, so that the numerical values tabulated must be considered as rough averages only. In dealing with the question of outside lighting, a distinction is made between the lighting of open spaces and the lighting of narrow roadways, and for use in estimating the latter the term "hemicyclic candle-power" is introduced, meaning the average candle-power taken over a single meridian of the lower hemisphere instead of over the whole hemisphere as in the case of the ordinary M.H.C.P. The book concludes with some useful fully-worked examples.

Electric Cables for Collieries. Paper read by Mr. G. G. L. Preece before the National Association of Colliery Managers on January 6th, 1906 (reprint from the *Iron and Coal Trades Review*). In addition to this interesting and informing paper, the new Special Rules of the Home Office for the use of electricity in mines, and a number of useful rules for finding cable sections, are bound together, forming a handy pamphlet for reference The whole can be had from Messrs. W. T. Glover & Co., Ltd., on application.

The Motor Manual. Ninth Edition, 1907 London: Temple Press, Ltd. Price 1s. 6d. net.—The fact that the book before us bears the words "ninth edition" is sufficient evidence that the *Motor Manual* is meeting a want. The general public is steadily showing a keener interest in motoring and motor-cars, and a desire to know something of those mysterious "innards" of the machine which makes the wheels go round, and it is with the object of slaking this thirst for knowledge that the *Manual* has been issued. In simple language the component parts and method of operation of the petrol motor are first dealt with, useful diagrams accompanying the text. A long chapter is devoted to the question of ignition, and the many side issues this important matter carries with it, the chapter being one which the novice motorist will do well to study closely. Succeeding chapters deal with such topics as "How to Select a Car," "Hints on Purchase," "Second-hand Cars," "What to Avoid," these being followed by a series of articles on the maintenance of the vehicle in good running order, once the would-be motorist has made the plunge. The law relating to motor-cars, and the taxes and licences connected with the same, find a place in the concluding portion of the book, which is one that can be recommended to all prospective motorists, especially to those unacquainted with the technical side of the modern means of locomotion.

"Fire Tests with Fire Extinguishers." Red book, No. 115, of the British Fire Prevention Committee. This contains the results of tests with the "Kyl-Fyre" dry powder extinguisher, which proved capable of smothering fires in their incipient stages.

"Building Contracts, Building Leases and Building Statutes, &c., together with an Appendix of Unreported Building Cases," by his Honour Judge Emden. Fourth edition. By J. Bridges Matthews and W. Valentine Ball. London: Butterworth & Co. 1907. Price 27s. 6d.

"Statistics of Public Education in England and Wales for 1904-5" (Board of Education). London: Wyman & Sons, Ltd. 1906. Price 2s. 5½d.

"Engineering Press Monthly Index Review." Vol. IX, No. 3, December, 1906. Brussels: Association de la Presse Technique. 2.50 fr.

"A Treatise on the Theory of Alternating Currents." By Alexander Russell, M.A. Vol. II. Cambridge: University Press; London: Mr. C. F. Clay, U. P. Warehouse. 12s. net.

"Transactions of the South Yorkshire Association of Mining Students." Vol. I, No. 6, November, 1906. London: The Chichester Press.

Consular Notes.—Siberia.—The United States Consul at Vladivostock, in a recent report, states that the municipality propose to raise a loan for an electric lighting and electric tramway system. The present idea is to construct a line from the eastern end of the town along the main street to the railway station and the market. One branch line northward into the country on the Aleutskaya or Kitaiskaya streets to first river, about 3 miles, would also probably be popular, as it would enable people to live in the suburbs. There might be a good chance for a line round the bay as well. First and second-class cars would probably be necessary

here. Altogether about 8 miles of line should be constructed. The streets are for the most part wide enough to accommodate a double track. As regards lighting, there are already a number of private plants, most of which supply other houses in their vicinity. This would be an important matter to be considered if a concession were applied for. The city at present states that it will want for street lighting, to begin with, about 200 lights of 1,000 and 500-c.p., and it is estimated that the private consumption will be from 5,000 to 7,000 lights of average candle-power. An increase would, of course, depend on the price and on the arrangements that could be made for limiting the private plants. The city has no funds available for beginning by itself even part of its ambitious programme, which also includes waterworks, sewerage, port and harbour works, paving, &c., but it is felt that these undertakings, if properly managed, should most of them be profitable investments. The municipality is desirous of securing a loan for the purpose of undertaking the construction and management itself, but it is generally agreed that there may be difficulty in getting the money in this way, and, therefore, it is open to consider propositions for (1) a loan secured on the work undertaken, the construction to be by the lenders or otherwise under their control; (2) a regular concession for construction and operation, the franchise to last, preferably, not longer than 20 years. No definite outline of the conditions prescribed has as yet been formed, and a proposition that required harder conditions in certain ways would have a chance of acceptance on account of other favourable points—such, for example, as exceptional solidity and standing of the applicants and guarantees for prompt and satisfactory execution of contracts. Lenders could not count on securing any interest or sinking fund payments from the present revenues of the city, but would have to base their calculations on securing the return from the works constructed. It is most essential that parties applying for the concession should have large capital and experience to command the confidence of the municipality and of the central Government. Of course, such an investment would require confidence in the future of the city, but upon this subject interested parties must investigate for themselves and form their own opinions. The Consul's feeling is that Vladivostock is likely to continue to be at least as important as now, and that these works could be made to pay on the present basis. This leaves out of consideration the tremendous growth possible with the rich country behind the port. Persons interested in the matter should communicate with the Mayor of Vladivostock. There will be many difficulties; but although the disadvantages may appear to be very great, the Consul is of opinion that the projects are well worth investigation.

P.D.M. Contracts.—Among recent contracts given to the Phœnix Dynamo Manufacturing Co., Ltd., are the following:—

For the Kent Electric Power Co., Chatham.—One 220-kw. induction motor-generator, the motor being three-phase 50 cycles 11,000 volts, and the generator 220 volts D.C.

For the Cleckheaton U.D.C.—82-kw. traction motor-generator and switchboard.

For the Johannesburg Municipality (to the specification of Messrs. Mordey and Dawbarn, and to the order of Messrs. Thwaites Bros.), a further four Phœnix-Pohl patent auxiliary pole motors.

For the Marylebone B.C. Electricity Department.—Further motors for auxiliary machinery in connection with the extensions now in progress.

Paterson Purifiers.—Among other orders lately received by the Paterson Engineering Co., Ltd., for their purifiers for power plant, are the following:—

Grease eliminator and make-up softener of 2,500 gallons hourly capacity for Coatbridge Electricity Works.

Messrs. J. G. White & Co., water purifier for Para Electric Railway and Lighting Co.

Erith Electricity Works, grease eliminator and make-up softener with quartz sand filter of 5,000 gallons hourly capacity.

Catalogues and Lists.—Messrs. Mavor & Coulson, Ltd., Glasgow.—On their December date-card the firm set out further data relating to a year's working record of one of their Pick-Quick electric coal-cutters.

British Insulated and Helsby Cables, Ltd., Prescot.—Catalogue (12 pages) fully describing their new Prescot electric welder.

British Thomson-Houston Co., Ltd.—Folding circular showing applications of their enclosed arc lamps for inside and outside shop illumination, public hall lighting, and street lighting.

Llewellin's Machine Co., King's Square, Bristol.—Illustrated and priced descriptive circular relating to their "Realm" time-checkers and recorders, oil-bathed reducing gear, concave worms and other specialities.

New British Electric Supply Co., Ltd., Stoke Newington Road, N.—Postal card illustrating their Arcazon arc lamps, standard, photo-printing and midget types. Reduced prices are announced for the 1906-7 season.

The "All-British" Card Systems Co., Thanet House, 231-2, Strand, W.C.—Illustrated catalogue of card index and vertical filing cabinets.

The General Electric Co., Ltd., London, E.C.—A new publication relating to their "Union" enamelled steel interior conduit, and announcing alterations in prices consequent upon rises in cost of materials. Two monthly blotters for November and December keep "Robertson" lamps in the mind of the recipient, and tell him that five million of these lamps are made and sold annually.

Messrs. Millington & Everitt, Jordan's Yard, Cambridge.—Illustrated circular briefly describing their Universal motor valve grinder.

British Doloment Works, Royal London House, E.C.—Attractively-produced circular bringing forward their "Doloment" jointless fireproof flooring, which is stated to have been largely used in Continental factories. It is claimed that although the foundation on which it is laid may settle or crack, the material retains an unbroken surface. It is non-porous, and can be made in almost any colour. Experience of the material at the Charlottenburg factory of Messrs. Siemens & Halske is said to have been perfectly satisfactory. The company have just completed a contract for H.M. Office of Works at the new Post Office, King's Road, Chelsea.

Messrs. Monte-Callow & Co., Ipswich.—Eight-page pamphlet describing the electric dynamometers manufactured by Hillairet Huguet, of Paris, for testing the horse-power of high-speed motors.

The British School of Telegraphy, of 179, Clapham Road, S.W., sends us a well-illustrated pamphlet describing the School, giving particulars of the courses offered, terms, &c. Mr. William Lynd is the principal.

Messrs. Crompton & Co., Ltd., London, E.C.—Two large postal cards containing illustrations and particulars of prices of their electric motors and arc lamps. Prices are very clearly indicated in red.

Bankruptcy Proceedings.—H. Diamant.—Under the failure of Hermann Diamant, described as a commission agent of 40, Broad Street House, E.C., the first meeting of creditors was held on Monday at the London Bankruptcy Court before Mr E. Leadam Hough, Senior Official Receiver. It appeared that, during the past 12 months the debtor had been occupied with the development of an electric lamp, of which he was a co-patentee. The Diamond Electric Arc Lamp, Ltd., was formed to acquire the patent, but has not yet gone to allotment. The debtor will be entitled to £3,000 in cash and shares, but he places no present value upon his interest therein. He was formerly interested in the development of an ozone apparatus, over which he lost £400. A receiving order was made against him upon the petition of Messrs. Bewick, Moreing and Co., and he attributes his failure to law costs in an appeal case. He succeeded in the first instance, and was awarded a verdict of £725 and costs, but on appeal the judgment was reversed, and through lack of funds he was unable to carry the case further. The liabilities are estimated at £784. In the absence of any offer, the case was left in the hands of the Official Receiver to be wound up in the ordinary course of bankruptcy, the debtor's public examination being fixed for December 20th. The following are the principal creditors:—

Unsecured.

Bewick, Moreing & Co., Copthall Avenue, E.C.	£380
Electrical Co., Ltd., Charing Cross Road, W.C.	15
Hands, J. J., 119, London Wall, E.C.	47
Isenthal, A., 41, Lime Street, E.C.	150
Christopher & Roney, 31, Cornhill, E.C.	150
Veritys, Ltd., King Street, Covent Garden, W.C.	41

J. M. Richardson.—The application of Jasper Myers Richardson, described as of Harvey's Buildings, Strand, for an order of discharge, came before Mr. Registrar Brougham on November 30th at the London Bankruptcy Court. According to the Official Receiver's report the applicant, in 1895, became joint manager of the Lithanode Co., Ltd., which was established for the manufacture of electric accumulators. That company went into liquidation in 1899, and during the following year the bankrupt promoted Longstreths, Ltd., to take over the Lithanode patents. He was appointed as managing director at a salary of £500 per annum, and resigned the position when he was made bankrupt in June, 1905. The liabilities amounted to £5,492, and the assets had realised £51, but some further sum might be received in respect of a book debt of £10,000 owing since 1882. On the ground of insufficiency of assets to pay 10s. in the £ to the creditors, the learned Registrar imposed a suspension of two years. Order entered accordingly.

Re G. W. Clarke, electrical engineer, of Harold Wood, and 117, Queen Victoria Street, E.C.—Notice of release of trustee (Mr. E. L. Hough, Official Receiver) on November 23rd, appears in the *London Gazette* for November 30th.

J. E. Austin.—The public examination was held on Wednesday last week at the London Bankruptcy Court, before Mr. Registrar Giffard, of John Edward Austin, late of 27, George Street, Portman Square, W., electrical engineer. The accounts show liabilities £1,471 8s. 6d. (unsecured £1,421 11s. 10d.), and net assets £31 3s. 4d., after deducting £19 16s. 8d., for the preferential claims. Questioned by Mr. E. L. Hough, senior Official Receiver, the debtor stated that he commenced business for himself in 1897 with £300 capital, at 23, York Place, Baker Street, subsequently removing to 40, Upper Baker Street. Then in March, 1905, he went from thence to 27, George Street, where the business was carried on until last June or July, when an execution was levied at the suit of a creditor. For some time past, witness had, through ill-health, left the business to the sole management of his son. Prior to starting on his own account, he (debtor) acted as manager of an electrical engineer's business. The trading resulted in a loss of £500 since October, 1903, and his household expenses during the same period amounted to £468. Pressure by creditors in the shape of writs had been constant since last March. The examination was concluded.

Trade Announcements.—Mr. P. J. Mitchell, of Westminster, has opened a Glasgow office to deal with Rateau patent exhaust steam utilisation plant, and his brother (Mr. F. L. Mitchell) is in charge. The address of the office is 144, St. Vincent Street, Glasgow.

The *Financial News* reports that arrangements have been completed for the amalgamation of the firms of Jessop & Appleby Bros. (Leicester and London), Ltd., and the Glasgow Electric Crane and Hoist Co., Ltd., under the style of Appleby's, Ltd., as makers of giant cranes, &c., with head offices at 56, Victoria Street, S.W.

Dissolutions and Liquidations.—Carnarvonshire Electric Traction Syndicate, Ltd.—This company is winding up voluntarily with Mr. F. B. Fuller, 13, St. Helen's Place, E.C., as liquidator.

Thames Valley Electric Supply Co., Ltd.—This company is winding up voluntarily with Mr. H. A. Stagg, Donington House, W.C., as liquidator.

Messrs. T. Reynolds & Co., gas and electrical engineers, 19, High Street, Coventry.—Messrs. Tom Reynolds and H. W. Archer have dissolved partnership, Mr. Archer retiring.

London and General Power Supply Co., Ltd.—This company is winding up voluntarily, with Mr. George Collis as liquidator. Creditors are to send particulars of their debts, &c., to Mr. Collis, Winchester House, E.C., by January 4th.

City of Buenos Ayres Tramways Co., Ltd.—Creditors must send particulars of debts, &c., to Messrs. H. A. Plumb and F. C. Crawley, 1, Great Winchester Street, E.C., the liquidators, by March 1st, 1907.

Cooper Patent "Anchor" Rail Joint Co., Ltd.—A meeting is to be held at Leeds on January 2nd to hear an account of the winding up from the liquidator (Mr. Wm. Crosland).

British Electric Car Co., Ltd.—A meeting is to be held at Broad Street Avenue, E.C., on December 31st, to hear an account of the winding up from the liquidator (Mr. T. F. Wild).

Correction.—We regret that in our reference to the Oliver Arc Lamp, Ltd., under "New Companies Registered" last week, two errors occurred. In line 8 for "Quinton" read *Quentin*; and in line 9 for "Hellyer" read *Hollym*.

Sumatra Rubber Trade.—The *Daily Telegraph* correspondent at the Hague reports that a plan is on foot to take energetic measures for developing the rubber trade in the Dutch Indies.

Electrical Industry in Japan.—The *Anglo-Japanese Gazette* says that the directors of the Mitsu Bishi Shipbuilding Co. have under consideration a scheme for the establishment of a factory to manufacture electrical plant. "This would seem to imply that the company intend enlarging the present factory at Nagasaki, where work of this description is now carried on."

LIGHTING and POWER NOTES.

Australia.—The Broken Hill City Council has decided to borrow £6,000 to extend the E.L. system. The whole route of the Government tramways will be lighted. Additional electric lighting plant will be ordered from England.—*Australian Mining Standard.*

Belfast.—On the recommendation of the electrical engineer, the Corporation has decided to apply to the L.G.B. for a loan to cover the cost of the following extensions:—Steam dynamos, boilers, switchgear, boosters and balancers, and foundations, £34,000; sub-station plant, £2,200; feeder cables and distributors for the central district of the city, £23,900; services and meters, £6,600; distributors for the Malone district, £3,750; contingencies, £3,650; total, £75,000. It is estimated that these extensions will suffice for about two years.

Blackpool.—The T.C. has decided to apply to the L.G.B. for a loan of £8,000 for the provision of a new turbine and condensing plant at the electricity works.

Bridlington.—The Electricity Committee has recommended the Council to reduce the price of energy for power and heating, which is at present on a sliding scale of 3d. to 2d., to 2d. up to 250 units per quarter, 1½d. after 250, and 1¼d. for specially large consumers.

Bradford.—The Corporation electrical engineer, Mr. Alfred S. Blackman, has submitted to the Electricity Committee a long report on the question of charges for the supply of energy. He suggests that a restricted hours' supply for power and heating purposes should be offered to consumers at a flat rate of ¾d. per unit, providing that no current is taken from the mains between half an hour before sunset and 7.30 p.m. Mr. Blackman also suggests the adoption of an alternative maximum demand rate for lighting of 7d. (one hour) and 1d. The rate at present is a flat one of 4d. per unit. Amongst the other suggestions made the free lamp supply (one of the best things yet done in the consumers' interests) should be extended by giving sufficient lamps to enable replacements to be made after 500 hours' instead of 1,000 hours' use. The cost of the free lamp supply last year was £1,002.

Canada.—Toronto.—In connection with the inauguration of the supply of energy generated at Niagara to Toronto by the Toronto and Niagara Power Co., our correspondent says that there was no formal ceremony, and the intention to switch in the transmission line on load was not generally known. The results were in every way satisfactory. For a long time past the Toronto Electric Light Co. has been seriously hampered for want of power, and quite recently the company sent a circular letter to its customers promising an improvement as soon as Niagara power was available. The Toronto Street Railway Co. has also been anxiously awaiting the arrival of Niagara power, in order to enable it to operate its cars to better advantage. The Toronto and Niagara Power Co.'s transforming station in Toronto forms part of the transmission system of the Electrical Development Co., Ltd., whose power plant installation at Niagara Falls is intended for the generation of 125,000 h.p. Power supply for Toronto will pass through the new transforming station, which thus becomes a kind of terminal for the 80-mile transmission lines of the company. The lines were specially manufactured of hard drawn copper wire twisted round a hemp core, and they weigh six-tenths of a pound per 1 ft. They have been constructed to withstand heavy strains and a wind pressure of 100 miles per hour without injury. The porcelain insulators are composed of three parts cemented together and tested to 120,000 volts. There are six of these lines, representing two three-phase circuits. Each circuit is capable of delivering 20,000 h.p. with a loss of 10 per cent. In the future, should more than 40,000 h.p. be required, a second similar line will be erected; only half the capacity of the new transforming station is now to be utilised.

The transforming station which has been almost completely equipped by the Canadian General Electric Co., of Peterborough (Ont.), is a two-storey building of vitrified brick 202 ft. long, 55 ft. wide and 45 ft. in height. On the ground floor are erected the L.T. oil transformers, and on the second floor the H.T. apparatus. Energy enters at a pressure of 60,000 volts, and is stepped down to 12,000 volts for delivery to the railway or light companies. Contracts have been arranged with the Toronto Electric Lighting Co. and the Toronto Street Railway Co., who will almost immediately utilise the new power supply.

The Niagara Falls Power Co.'s generator, which is one of four to be put into operation, is capable of generating 15,000 h.p. It is the most powerful machine of the kind in the world to-day, and it may be of interest to state that it was made in Canada by the Canadian General Electric Co., of Peterboro, Ont. Three other similar machines will be installed in the near future.

The Hydro-Electric Power Commission has received a considerable number of additional requests to be supplied with power from various municipalities, including the following:—Dundas, 3,000 h.p.; Milton, 500; Ingersoll, 1,350; Acton, 800; Norwich, 2,000; Windsor, 5,000; Simcoe, 500; Elmira, 600; Tillsonburg, 1,000. This brings the aggregate demand to over 100,000 h.p. The Chairman has announced that the Commission is now able to supply Toronto with a maximum of 50,000 h.p., and a minimum of 25,000 h.p. at from $17 to $17.50 per horse-power, 24 hours' service, and possibly as low as $14 per horse-power, per annum.

Mayor Ellis, of Ottawa, has made arrangements with the Hydro-Electric Power Commission, whereby the city may obtain power to the amount of 3,000 h.p., down to 1,500 h.p., on a ten years' lease, for the sum of $15 per horse-power.

Peterborough (Ont.).—The municipality has received an offer from the Peterborough Light and Power Co. for the sale of its business to the city at cost price, *i.e.*, approximately $250,000.

Carnarvon.—The T.C. has at last elicited from the B. of T. that it will not be necessary to promote a private Bill in Parliament to legalise the agreement with the National Electric Construction Co., as the agreement is not, as was at first thought to be, on all fours with that which led to the Sudbury litigation.

Continental Notes.—Spain.—An electricity works is to be erected at Valladolid by the Soc. Electra Vallisoletana.

Italy.—The provincial authorities of Naples have approved the erection of electro-hydraulic works on the Volturno. The energy generated will be used for industrial purposes round about Naples. The entire cost of the work is estimated at 9,750,000 lire. This figure includes, however, the cost of spare plant with steam generators at the receiving station near Naples.

Important work is now being carried out on a large flume from the River Cismon in connection with the 20,000-h.p. long-distance transmission scheme for supplying energy to the Padua, Schio and Polesine districts.

It is reported from Milan that the scheme proposed by the municipal council of Milan for the establishment of a large electricity works has been advanced a stage nearer realisation. The question at issue is the projected utilisation of 40,000 h.p. obtained from the upper course of the River Adda and its tributaries between Tirano and Bormio in the Veltlin. It is proposed to install plant for generating this power and transmitting it to Milan for the working of the tramways and for lighting purposes, together with the private supply, all of which are now in the hands of the Edison Co. After lengthy negotiations, the Milan Municipal Council and the interested local authorities in the Veltlin have just concluded an agreement which is said to satisfy both parties. The arrangement provides for Milan making a single payment of £2,000 to the province of Sondrio and the local authorities concerned, for the rights appertaining to the concession, and an annual payment of 1s. per horse-power obtained, whilst at the same time Milan agrees to reserve 2,500 h.p. for the operation of an electric railway from Tirano to Bormio, and to provide the water necessary for the irrigation of the fields. The conclusion of the agreement removes the obstacles which have hitherto stood in the way of the concession being granted to the town of Milan.

Coventry.—The report of the E.L. Committee in regard to the recent breakdown at the electricity works, was issued on Friday last. The Committee stated that on September 1st, 1905, the boilers consisted of a bank of six of different capacities. These six boilers had proved themselves capable of working the three 600-KW. sets. One new boiler would probably be at work by the time this report reached the Council, and the second boiler was in place, and would be at work within 10 days. These two boilers, according to contract, should have been completed by October 12th, and it was owing to the non-delivery of these that the boilers had to be working without being cleaned at the proper time, and in consequence were unable to stand the extraordinary pressure caused by the abnormal output on November 9th. The report deals with the remedies proposed to be adopted in the future. The Committee thinks that on no account ought any new consumers to be connected up when once the maximum output has reached 2,400 KW., so that there shall always be 900 KW. in reserve. Owing to the abnormal increase in the demand for power, there are at present in hand applications more than sufficient to absorb the balance of power which will be in hand when the present extensions are completed, and the Committee is, therefore, faced by the fact that it cannot accept further applications for energy, or it must immediately proceed to consider a further scheme of extensions, which will be costly. It proposes, subject to the sanction of the Council after a draft scheme of extensions has been prepared by the engineer, to submit the scheme for the advice of an electrical expert of high standing.

Edinburgh.—The E.L. Committee, accompanied by Sir Alexander Kennedy, on the 29th ult. inspected the Corporation power stations, and visited several places with the view of obtaining information as to how water can best be obtained for condensing purposes at M'Donald Road Station.

Failsworth.—A canvass is to be made by the U.D.C. with the object of ascertaining the number of likely customers. If the results are satisfactory the Manchester T.C. will forthwith take steps to provide a supply.

Foot's Cray.—The U.D.C. has sealed an agreement transferring the E.L. order to the Foot's Cray E.L. Co., which will pay the Council the costs incurred in obtaining the order.

Kent.—It has transpired that the total cost to the Kentish Borough and Urban Councils, on account of their opposition to the Kent Electric Power Bill in Parliament, amounted to £496. Application has been made to the various authorities concerned for payment based upon an average of 3s. 6d. per £1,000 rateable value.

London.—HACKNEY.—Application is to be made by the B.C. to the L.C.C. for a loan of £9,501 for public lighting by flame arc lamps.

MARYLEBONE.—The B.C. denies that the electric lighting standards and refuges down the middle of Oxford Street are an obstruction as stated by the L.C.C., and asserts on the contrary that they are useful for regulating traffic. Any attempt by the L.C.C. to obtain greater power of interfering with the duties and powers of the B.C.'s, in connection with the streets, is to be opposed by Marylebone.

ST. PANCRAS.—A correspondent informs us that it is the intention of the Electricity Committee to consider the question of yellow flame arcs as soon as a satisfactory lamp of that description is on the market.

ISLINGTON.—The Lighting Committee of the B.C. is going fully into the details of the scheme adopted by the late Council in March last for the extension of arc lighting in the borough, at an estimated cost of £21,000, and pending the result of the inquiry the electrical engineer is to proceed no further with the works except where cables have been already laid down.

L.C.C. LOANS TO BOROUGH COUNCILS.—At Tuesday's meeting of the L.C.C., the Finance Committee recommended the Council to advance to the Hammersmith B.C. the sum of £1,366 for buildings, £6,052 for mains, sub-stations, switchgear and transformers, £9,621 for machinery and tools, and £1,946 for meters and house services, the first three items to be repaid in 15 years, and the meters and house connections in 10 years. An animated debate took place, and eventually on the motion of Dr. Beaton, seconded by Mr. Hardy, an amendment was adopted by 30 votes to 27, referring the recommendation back to the Committee for further consideration. A discussion also ensued on a recommendation by the Committee in favour of the granting of a loan of £12,663 to the Islington B.C. for electric lighting works, out of a total of £16,658, for which application had been made. An amendment was proposed to refer this recommendation back also, but this was eventually withdrawn, and the Committee's suggestion adopted. Out of the total sum applied for, the amount of £2,954 was for the acquisition of freehold property, and for building works. With regard to the remainder, the Finance Committee made the following remarkable observations:—

"The amount applied for (£12,704) for machinery, mains, meters, &c., is required as to £4,818 for work recently executed, as to £4,861 for work executed between 1896 and March, 1905, and as to £3,025 to cover expenditure which has been incurred also between those dates upon wages (£2,699), travelling expenses of electrical engineer whilst inspecting plant (£107), the purchase of coal, oil, &c., used in testing (£219), and which the Borough Council considers is properly chargeable to capital account. The Borough Council is unable to supply us with full particulars of this expenditure, but has offered to place its books at the disposal of the Council. It appears to us that if the Borough Council itself is unable to supply details of the expenditure, an examination of its books would not lead to any profitable result, and, moreover, we do not think it right that the Council should undertake such an examination, which would involve considerable labour; and, in the absence of further information, it is not possible to say whether this expenditure should be charged to capital or maintenance account. In view of all the circumstances, and in particular of the fact that some of the expenditure was incurred some years ago, we are not prepared to recommend the Council to sanction the amount of £3,025.

"The £4,861, above referred to, has been expended, as to £4,066 on machinery and instruments, and as to £795 on meters. The £4,066 was expended between 1896 and 1904, and we understand that, together with other loans which have been raised by the Borough Council, it covers all expenditure up to March 31st, 1904, on machinery and instruments properly chargeable to capital account. The expenditure (£795) on meters has been incurred between August, 1903, and March 31st, 1905, in respect of which no money has yet been borrowed. We think that the Council might sanction the borrowing of these amounts, but, in consideration of the work having been executed at various times during the last 10 years, we suggest that the Borough Council should be required to repay the £4,066 in 15 years instead of 20 years, which would otherwise have been allowed.

"The balance, £4,818, above referred to is in respect of feeder pillars (£1,024), low-tension mains, &c. (£1,696), excess cost of an artesian well (£138), and connections with consumers' premises (£1,960). The works have been recently executed. We are advised that the cost is reasonable, and think, therefore, that the amount may be allowed.

"The amounts to be sanctioned and the periods of repayment should therefore be as follows: Freehold property (£1,248), 60 years; buildings (£1,706), mains (£2,720), artesian well (excess cost, £138), together, £4,564, 30 years; machinery and instruments (£4,066), 15 years; house connections (£1,960), 12 years; and meters (£795), 10 years.

"With regard to the delay which has taken place in applying for sanction to a portion of the loan, we consider that it is undesirable that a borough council should incur expenditure during a number of years, and then apply for a loan to cover such expenditure. Delay in applying for a loan necessarily renders it difficult for proper consideration to be given to all the questions involved, and, in the case of the £3,025 above mentioned, the delay has made it impossible to determine on the information supplied by the Borough Council whether the expenditure is a proper capital charge. Moreover, if a loan is not raised within a reasonable time of the work being executed, the undertaking is unequally burdened in respect of loan charges during different years. Until the loan is raised no sinking fund charge is made against the undertaking in respect of the particular work for which the loan is needed, and during the currency of the loan the undertaking is unduly burdened owing to the necessity for curtailing the period of repayment so that it may not exceed the estimated life of the work. We have communicated with the Borough Council upon this matter and have expressed our hope that the Council will not again be asked to sanction loans to defray the cost of work long since executed."

L.C.C. POWER SCHEME.—The Poplar Municipal Alliance, which has of late been very active with respect to the Guardians' scandals, is endeavouring to obtain united opposition on the part of all similar local associations in and around London against the L.C.C. bulk supply scheme. We understand that 34 associations have agreed to the proposal for combined opposition.

THE L.C.C. AND THE ACCOUNTS OF COMPANIES.—The Highways Committee at the meeting last week submitted the following report:—Some time ago we drew the attention of the Council to the fact that the auditor appointed by the Board of Trade had, in his certificates with reference to the accounts of certain of the undertakers under Electric Lighting Acts and Orders, pointed out that certain expenditure, *e.g.*, for directors' and auditors' fees, salaries and expenses of management, promotion money, and interest on loans and advances, which had been charged to capital account, should be transferred to revenue account or to preliminary expenses account; but that the companies concerned, acting on the advice of their own auditors, had declined to comply with the requirements of the Board of Trade auditor. This question has again arisen in connection with the audit of the accounts of the electric lighting companies for the year ended December 31st, 1905. In the report of the official auditor upon the accounts of one company, he draws attention to the fact that the overcharge to capital account in respect of directors' fees has not yet been corrected, also that certain unrealisable assets have been included in the balance-sheet, and that the provision for depreciation is inadequate. The Council has on several occasions brought to the notice of the Board of Trade the fact that the action of the companies in charging to capital account amounts that should not be so charged was of importance from the point of view of local authorities and consumers in relation to two matters, namely (1) in connection with the periodical revision of the maximum charges for current, as in considering in each case the question whether these charges should be reduced, regard must be had, among other things, to the rate of dividend paid by the company, and, if the capital be larger than it should be, the profit distributed would show a lower rate of dividend; and (2) in regard to the price to be paid for the purchase of the undertaking by the local authority. It appeared that there was no machinery in the Electric Lighting Acts for enforcing objections raised by the public auditor; and the Council suggested to the Board that those Acts should be amended somewhat in the direction of Sections 40 and 42 of the Metropolis

Water Act, 1871, which empowered the auditor of metropolitan water companies' accounts to require any company to correct them in such a manner as he might think fit, and provided that no future dividend should be declared by the company until its accounts were certified by the auditor, an appeal, however, being allowed from his decision to an arbitrator, to be appointed by the Lord Chief Justice. The Board stated at the time that it was not disposed to regard the suggested amendment as necessary, as it was of opinion that the practice of forwarding to the Council and to the local authorities affected a copy of the report made by the auditor in any particular instance, and of the correspondence relative thereto, fully met the points raised, but that, in the event of an opportunity presenting itself of amending the Electric Lighting Acts, careful consideration would be given to the suggestion. No action has yet been taken in this direction, however, and as cases are still arising in which the Board's auditor finds it necessary to take exception to the form in which electric lighting companies' accounts are issued, we suggest that the Board should be again approached on the matter. It has also been represented to us that facilities should be afforded to the representatives of the local authority having powers of purchase to discuss with the official auditor any questions which may arise on the accounts, and we understand that the Board of Trade are now considering this question. We think that this request is reasonable, and that it should be supported by the Council.

Mountain Ash.—The U.D.C. has decided to obtain the opinion of another expert with reference to the proposed E.L. scheme.

The Council has also decided not to allow the South Wales Electrical Power Co. to withdraw from its obligations as to lighting certain portions of the district, but at the same time not to press the company to carry out the obligations.

Mynyddislwyn.—Before consenting to support the application of the Rhymney Valley General Electric Supply Co. for a prov. order for E.L., the U.D.C. has asked for fuller particulars of the scheme.

Sidmouth.—The U.D.C. is negotiating with the Electric Supply Corporation for the transfer of its E.L. prov. order.

South Africa.—Cape Town.—The city electrical engineer has supplied the Electricity and Waterworks Committee with particulars of quotations received from Messrs. Babcock and Wilcox for the supply of the necessary stoking machinery, to enable the Council to be in a position to utilise Natal coal at the electricity works.

Pietermaritzburg.—At a meeting of the Pietermaritzburg Town Council on November 6th, a recommendation from the Electric Light Committee was brought forward to charge electric current consumers on a "sliding scale" from 9d. to 6½d. per unit, less 5 per cent. for cash if paid within seven days, the minimum charge to be 5s. per month. It was, however, referred back with a recommendation of a "flat" rate of 8d. per unit.

South America.—The Pergamino E.L. Co. has been acquired by Messrs. Geiger, Zublin & Co., of Buenos Ayres. The new owners contemplate the construction of an electric tramway in the town, and also the laying down of a line to Salto, which would place the town in communication with the Federal capital.

The Electric Light Co., of Suarez, has accepted the tender of the Cia. Industrial de Electricidad for the supply of the entire plant at a cost of $37,000 gold. It is anticipated that the works will be opened about May next.

The directors of the Cia. de Electricidad de la Provincia de Buenos Ayres, in their report on the first year's working, state that the company now owns stations at Adrogué, Quilmes, Tres Arroyos, Azul and San Nicolas. The profits on the year's working amounted to $97,402, which allows of a dividend of 11 per cent. being declared.

The Buenos Ayres municipality has granted a concession for 15 years to Messrs. Gullard & Co., for the installation of 500 electric clocks throughout the city. One clock will be erected in each square and all cables for the service must be placed underground.—*Review of the River Plate.*

Stalybridge.—The Stalybridge, Hyde, Mossley and Dukinfield Joint Electricity and Tramway Board, on November 30th, decided to apply to the L.G.B. for power to borrow a further sum of £20,000 for extensions of plant at the generating station at Stalybridge. It is proposed to erect a new turbine generator to increase the capacity of the plant from 1,500 H.P. to 6,000 H.P. The new turbine will cost £8,000, and equipment £2,000; and it is eventually to be duplicated, thus accounting for the £20,000.

Stockport.—The T.C. is applying to the B. of T. for additional powers under the E.L. Acts. The powers sought include the right to refuse to supply energy to persons in arrear of payment; to exempt from distress or seizure fittings, &c., hired from the Council; to enable the Council to allow discounts; and to make special provision with respect to the rights and obligations of the Council to afford a supply of energy to premises having a separate supply.

Sunderland.—A L.G.B. inquiry was held last week into the application of the T.C. for a loan of £21,642 for E.L. purposes. Additional plant is required to supply large works which will require 2,500,000 units per annum. There was no opposition. Mr. Snell, the borough electrical engineer, said that during the year ended March last 6,159,000 units were sold; and it was expected that during the year ending March next the sale would reach nearly 8,000,000 units. A fifteen years' agreement had been entered into with Messrs. Doxford & Sons, shipbuilders, for a further supply of 2½ million units annually, which would raise the output to over 10,000,000 units per year.

Walthamstow.—At the meeting of the U.D.C. on Friday last the Lighting Committee reported having considered a communication from the electrical engineer with reference to the provision of steam engines and additional plant at the generating station. It recommended that tenders be invited for supplying machinery, &c., as follows:—(*a*) Boiler-house plant, consisting of three boilers and the necessary auxiliaries; (*b*) engine-house plant, consisting of three engines, condensing plant, &c.; (*c*) buildings. This recommendation was adopted. The resolution passed in June last with reference to making application to the L.G.B. for sanction to borrow £16,755 for additional plant at the generating station was rescinded. Upon the acceptance of the tender for the plant, &c., before-mentioned, application is to be made to the L.G.B. for sanction to borrow the amount of such tender. Mr. Holmes and Mr. Spurr were directed to prepare the necessaay plans, specifications and estimates. The electrical engineer submitted a scheme and estimate for the lighting of Highams Park district, with provision for possible future extensions. Two boosters would be placed near the Forest Road for regulating the pressure. Instructions were given for arrangements to be made to carry out a canvass of the district as soon as possible.

Wednesbury.—A difference having arisen with the British Accumulator Co. respecting the battery of accumulators supplied to the Corporation at the sub-station, the Lighting Committee has decided to take steps for the settlement of the difference by arbitration, in accordance with the agreement entered into with the company. Application is to be made to the Local Government Board for sanction to a loan of £1,000 required for mains extensions in various parts of the borough.

Worthing.—The Electricity Committee of the T.C. has recommended that the charge for energy for heating purposes between certain hours be reduced from 2d. per unit to 1½d. per unit during the whole day, from April 1st to March 31st, and that the charge for power also be reduced from 3d. per unit. to 1½d.

Wrexham.—The Electricity Committee has recommended that inquiry be made of the borough electrical engineer at Salford if he would be prepared to report on the working of the electricity undertaking. The Council has arrived at no definite decision on the subject.

TRAMWAY and RAILWAY NOTES.

Birmingham.—On the 27th ult. the Corporation approved of the Bill submitted by its Tramways Committee, seeking powers to construct tramways through Edgbaston to Harborne.

Continental Notes.—Belgium.—La Cie. Générale des Tramways d'Anvers is preparing plans for the electrification of the tramways between Antwerp and Brasschaet, and Antwerp and Schooten.

A company has just been formed in Brussels, with a capital of £80,000, to construct and work an electric tramway between Salerne and Valle de Pompei.

Italy.—The Eridano Electrical Co. is increasing its capital in connection with its electrical undertaking at Cremona, and is applying for permission to construct an electric tramway.

The Brivio Council is endeavouring to promote an electric tramway scheme for the construction of lines between Bergamo and Como, along the main provincial road, thus facilitating access to the St. Gothard main line.

Details for the construction of an electric tramway between Varese and Angera have been worked out. The total length is put at 29 km., and it is intended to deal with both passengers and goods.

Germany.—The Prussian State Railway authorities have now started the series of trials which are to be carried out on the experimental railway which has been constructed in the wood of Oranienburg, near Berlin, and to which reference was made in this journal some time ago. The railway, which has been laid in the shape of an oval, has a length of 1,756 metres, and in addition to the curves, it has two straight lengths of 250 metres each. As the special object of this short railway may be mentioned the testing of all classes of material used in the construction of permanent way, and for this purpose the railway has been laid with different kinds of ballast, with wood and iron and steel sleepers, and with various kinds of rails and rail joints. The railway is traversed day and night by a motor-car or train which is supplied with single-phase alternating current at 6,000 volts by means of an overhead conductor energised from the electricity works of the town of Oranienburg. In addition to obtaining records of the use of the various materials employed in the construction of the permanent way, it is

intended to make experiments with automatic signalling apparatus, and with electric motor-cars for the purpose of gaining information bearing on the problem of the proposed adoption of electric traction on the Berlin city railway.

An increase in the share capital is proposed by the directors of the Berlin Elevated and Underground Electric Railway Co., notwithstanding the intimation given at the extraordinary meeting held last April that the next emission of shares would only be proceeded with in 1908. The company was formed in 1897 with a share capital of £625,000; in 1901 the capital was advanced to £1,000,000, and a further increase to £1,500,000 took place in 1902. It is now intended to make a fresh issue of ordinary shares amounting to £500,000, thus bringing the total ordinary capital up to £2,000,000. In addition, the company had a 4 per cent. obligation issue of £625,000 down to the end of last year, and in the current year a fresh emission has been made in the form of 3½ per cent. obligations, which have raised the total to £985,000. The new shares are being taken over by a group associated with the company, and they will not be entitled to dividend until 1909. It is assumed that compensation for the loss of interest on the new capital will be afforded by the shares being subscribed at par value instead of being taken over at a premium, as in the case of the two previous issues. The shareholders in the company received down to 1902 4 per cent. interest, which was guaranteed by the contractors (the Siemens & Halske Co.), and since then dividends have been paid out of the profits at the rate of 3½ per cent. for 1903, 4 per cent. for 1904, and 4½ per cent. for 1905.

Dewsbury.—Subject to the consent of the B. of T., the T.C. has decided to lease the tramways to the B.E.T. Co., which will pay a yearly rent of £674.

Edmonton.—The U.D.C. has resolved to oppose an application to the B. of T. by the Metropolitan Electric Tramways for permission to increase the speed of running in the district from 10 to 12 M.P.H.

A commencement has been made with the laying of the new Middlesex C.C. light railway from Waltham Cross to Edmonton, where it will be connected with the Metropolitan Electric Tramways system.

Isle of Wight.—The daily Press has reported that a scheme for the electrification of the Central Railway has been suggested to the County Council. The Parliamentary and Railway Committee is to submit a further report on the subject.

Jarrow.—On the 28th ult. the new system of the Jarrow and District Electric Traction Co., from Jarrow to Tyne Dock, was formally inspected by Colonel Von Donop, of the B. of T. During the course of the trial run the Jarrow Corporation officials drew the Inspector's attention to levels in Ormonde Street to which they took objection, and Colonel Von Donop suggested that the tramway company might confer with the Corporation, but meanwhile that section of the line would not be sanctioned. At the east side of the Don Bridge Mr. Burgess, on behalf of the South Shields Corporation, said certain improvements were necessary in regard to which an arrangement had been come to. The cost would be £450, of which the company would contribute £300. Mr. Rollins, of the Hedworth Barium Works, objected to the construction of the track at the level crossing near the works, and said he was afraid of a stoppage at his works in the event of a breakdown. Colonel Von Donop said the crossing would be sanctioned provisionally, and if there were any signs of its giving way, and the Barium Co. communicated with the B. of T., the matter would be gone into fully. On the return journey the speed limits were fixed.

Lancashire and Yorkshire Railway.—On December 3rd a new service of electric trains between Liverpool and Aintree, *viâ* Walton Junction and *viâ* Linacre Road, was inaugurated. In consequence of these new electric trains serving the intermediate stations between Liverpool and Aintree, the main line trains will be accelerated. On week days there will be 48 trains in each direction.

London.—Great Northern, Piccadilly and Brompton Railway.—It is announced that this tube line will be officially opened for traffic on the 15th inst. The total length of route is about 9 miles, and the fares will range from 1d. to 4d.

L.C.C.—The Highways Committee at Tuesday's meeting submitted a report in regard to the proposed reconstruction of the tramways in Holloway Road, Hackney Road, City Road and Bow Road. It was important that the work should be commenced as soon as possible, and the Committee proposed to invite tenders for the execution of the road work and plate laying, so that the tenders might be received and reported on immediately after the recess.

Manchester.—The general secretary of the Tramway Men's Union, before the Tramways Committee last week, stated that the conductors objected to the new parcel-carrying arrangements. They objected to the extra work and the responsibility for the parcels in case of loss. The cars were not made for parcel carrying, a fact with which we agree. If the Corporation desired to run a parcel department, it was urged that it should provide special cars.

New South Wales.—The New South Wales tramway system is undergoing very rapid development, as illustrated by some figures quoted recently by Mr. G. Cowdery, engineer of the Tramway Department:—In 1889 the mileage of city and suburban tramways was 50, and at the end of June 30th, 1906, the total was 157 miles; the expenditure on the permanent way in 1889 was £24,000; in 1906, £66,853. The number of passenger fares collected in 1889 was 52,810,026, and in 1906 the number was 125,756,680; the total earnings in 1889 were £225,833, and in 1906 for the city and suburban lines £730,508, or, taking in the Newcastle and Broken Hill systems, 851,438; the capital laid out in 1889 totalled £771,255, while in 1906 this had increased to £2,966,704; the total mileage covered in 1889 was 1,338,386, and this had increased to 14,246,845 miles in 1906.—*Australian Mining Standard.*

South America.—The owners of the La Plata Nacional Tramway have applied for permission to electrify the lines. Plans for an electric tramway between Buenos Ayres and Tigre have been approved by the Buenos Ayres municipality.

Tasmania.—Launceston.—The ratepayers having decided to allow the construction of trams within the municipality to be carried out by private enterprise, the following conditions to be complied with by the company obtaining the right, have been adopted by the City Council:—(1) Gauge, 3 ft. 6 in. (2) Rails, 83 lb. per yard. (3) The permanent way to be constructed on the cross-sleeper method, macadam roadway to be constructed between rails and 18 in. outside outer rail, and maintained by the company; all poles and overhead equipment to be of the most up to-date pattern. (4) Cars to be single deck. (5) Company to construct, at its own expense, all necessary works on the roads, and make all arrangements with the Electric Telegraph Department and all local bodies interested; the company to take energy from the Council. (6) Services and fares on the sections to be approved by the Council. (7) 3 per cent. to be paid to the Council on the gross earnings in lieu of municipal rates, and no rates to be made for the first three years from the opening of line. (8) £5,000 to be deposited with the Council at the signing of the agreement for due fulfilment of obligations within two years; the work to be completed within six months from date of agreement, and to be continuous until completion. If works are not commenced or completed within the specified periods, the deposit to be forfeited, and the Council may cancel the agreement. (13) The Council and the Gas Co. to have power to lay or repair pipes, &c., under the tracks without compensation to the company. (14) The Council to have the right of purchase at the end of twenty-one years. The purchase money to be ascertained by arbitration, but nothing shall be allowed for the goodwill or prospective value. (15) If the right of purchase is not exercised in twenty-one years, the Council shall have the right to do so at the end of each succeeding seven years on the same terms. (16) Applications to be invited for the construction of electric tramways for Launceston and suburbs, and particulars to be obtained from the town clerk. (17) Plans and specifications to be prepared and submitted with application for approval of the Council. The construction, working and maintenance of the permanent ways, trams and lines to be done to the satisfaction of the city engineer.—*Australian Mining Standard.*

Torquay.—The T.C. has applied to the Dolter Electric Traction Co. for information as to when the cars are likely to be running and the various routes completed.

Wood Green.—On the 29th ult. Sir Francis Cory-Wright, chairman of the Light Railways Committee of the Middlesex C.C. opened the new electric tramway from Wood Green to New Southgate.

TELEGRAPH and TELEPHONE NOTES.

Buenos Ayres.—The City Council has resolved that all wires for messenger call services must be placed underground within six months, under penalty of a fine of $100 for every day's delay thereafter. This will mean that the messenger service will be abolished, as no company can undertake the heavy expenditure involved.

Canada.—Manitoba.—At a convention of municipal representatives held at the beginning of November, it was resolved that the telephone law passed by the Government of the Province required amendment; at the same time the convention reaffirmed its belief in the municipalisation of the telephone business.

A heavy snowstorm, which lasted 48 hours over a large area of Western Canada and the North-Western States last month, did a great deal of damage to telegraph and telephone wires, hindering railway traffic and cutting off communication.

China.—The Russian telegraph line from Tien-tsin to Tienchwang-tai and from there to the Liao-ho, part of which has been in Japanese hands since the Japanese occupation of Niuchwang, has been transferred to the Chinese Government.—*Daily Mail.*

Chinese Place-Names.—According to *l'Industrie Electrique*, telegraphic correspondence with China must be a somewhat trying business, as the names of towns are so frequently practically duplicates, for example:—Chank-Lo and Chang-Loh; Ho-Chow and How-Chow; Ngan Tin and Ngan Ting; Ling-tin-Ling and Ting-yin-Ting! The Chinese must be devoutly thankful

that (as we suppose) these towns are not connected by telephone trunks. Fortunately, the Director-General of Telegraphs of the Chinese Empire has appointed a Committee to regulate the orthography of the names of towns. At present errors occur incessantly, though, thanks to the Chinese aptitude for taking pains and disregard of time, a message invariably arrives at its destination at long last, be it a year in transit!

Iceland.—Iceland has signified her adherence to the Telegraph Convention as from October 1st last.

New Cable.—The International Bureau at Berne notifies that during August and September last the German Government laid, at the joint cost of themselves and Norway, a submarine cable connecting Cuxhafen and Arendal. The cable lands at Duhnen, near Cuxhafen, is 651·732 kilometres in length, and contains only one wire. It was opened for traffic on September 9th.

New Zealand.—In order to compel the payment of overdue subscriptions, the Christchurch telephone authorities, after giving ample warning of their intention, disconnected no fewer than 600 stations in one day. The effect was immediate; for a time the central office was blocked with subscribers anxious to pay up, and it is expected that no difficulty will be experienced in securing payment next time.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	
Trinidad-Demerara (No. 2.)	Dec. 3, 1906	
Paramaribo Cayenne	Nov. 27, 1906	
Cayenne-Pinheiro	Aug. 15, 1902	
St. Lucia-Martinique	May 7, 1902	
Dominica-Martinique	May 7, 1902	
Guadeloupe-Martinique	Aug. 29, 1906	
Mole St. Nicholas-Port au Prince	Aug. 16, 1906	
Curacao-Coro Curacao-La Guayra Curacao-Maracaibo	Closed.. Jan. 12, 1906	
Reissa-Issa and Reissa-Yemani (Yemen)	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Port Arthur-Chifu (Closed)	Mar. 9, 1904	
Garachico-Santa Cruz	July 12, 1906	
Las Palmas-Arecife	Aug. 18, 1906	
Guantanamo-Mole St. Nicholas	Nov. 22, 1906	
Mole St. Nicholas-Cap Haytien	Nov. 22, 1906	
Gibraltar-Tangier	Dec. 3, 1906	
Fao-Bushire	Dec. 4, 1906	
Landlines.		
Puerto-Barrios	Aug. 28, 1902	

Trans-Saharan Telegraph.—The *Times* of December 1st gives particulars of the overland telegraph line joining the French Mediterranean with the Sudanese Colonies of West Africa, *viâ* the Sahara. The head office will be at Adrar, 1,200 km. from the coast.

Wireless Telegraphy.—The experiments in wireless telegraphy between Landikotal and Peshawar, India, have proved entirely successful, and have demonstrated that the interposition of higher mountains does not interfere with free communication between two places in a mountainous country.

In an interview with a representative of the *Daily Mirror*, Lord Armstrong is stated to have said "it is certain that cables in the near future will be entirely superseded." It cannot be too clearly understood that wireless elegraphy lacks the essential element of secrecy. For domestic messages this does not matter much; but for business messages, which constitute the great bulk of the traffic on submarine cables, secrecy is indispensable, and it is most unfortunate that such radically misleading statements should be put forward on high authority. Lord Armstrong went on to say "Another marvel of the system which is being brought to perfection will be the wireless telephone." "Will be" is good. We may add that most interesting results may be anticipated when we are able to visit Mars—and return. In the meantime, let Mr. Poulsen be content with the honour which is undoubtedly due to him for the progress *actually* accomplished; and Lord Armstrong may, with advantage, read an article in the current issue of the *Monthly Review* on "Wireless Telegraphy" by Mr. Charles Bright.

CONTRACTS OPEN and CLOSED.

OPEN.

Belfast.—December 31st. 1,000-KW. steam dynamo and condensing plant for the Corporation. See "Official Notices" to-day.

Bohemia.—The municipal authorities of Philippsdorf are about to invite tenders for the electric lighting of the public streets of the town.

Bray.—January 1st. High-tension switchboard and instruments for the U.D.C. electricity works. See "Official Notices" November 30th.

Bridlington.—January 19th. Pumping machinery for the Corporation waterworks. See "Official Notices" November 30th.

Bury.—December 22nd. Cables for the Corporation. See "Official Notices" to-day.

Cingoli (Italy).—January 11th. The Council intends to provide electrical illumination for the city. The terms upon which those wishing to compete for the work can do so are set out in *Electricity*, of Milan, for November 16th, 1906. The proposal must be sent in by January 11th, 1907, to Signor F. Mattioli, the Mayor, Cingoli.

Felixstowe.—December 22nd. Switchboard for the U.D.C. See "Official Notices" to-day.

Handsworth.—December 15th. Water-tube boilers, engine and dynamos for the U.D.C. See "Official Notices" November 30th.

Hull.—December 10th. The Education Committee of the Corporation invites tenders for electric light installations, fittings, and fans required at the Villa Place School, now in course of erection. Joseph H. Hirst, City Architect, Town Hall.

Iceland.—March 31st. The Reykjavik Town Council is open to give a concession for supply of electric energy and gas. See "Official Notices" to-day.

India.—December 12th. Electric cranes for the East Indian Railway. See "Official Notices" November 30th.

Islington.—December 28th. Fan 12 ft. diameter, and single-phase motor for driving same, for the Lighting Committee. See "Official Notices" to-day.

Launceston (Tasmania).—January 21st. Three-phase motors for one year. See "Official Notices" to-day.

New Zealand.—February 14th. The Auckland Municipal authorities require tenders by February 14th, 1907, for engines, dynamos, boilers, switchboards, cable and other electrical plant. Particulars may be obtained from the city engineer.

Portsmouth.—December 7th. Steam and other piping for the Corporation. See "Official Notices" November 30th.

Portsmouth.—December 17th. Electric power cables for the Corporation works for the prevention of storm-water flooding. See "Official Notices" November 30th.

Rawmarsh and Swinton.—Free wiring installations for the Mexborough and Swinton Tramways Co. See "Official Notices" November 30th.

Rochdale.—Static transformer and switchgear pillars. See "Official Notices" November 30th.

Spain.—December 20th. Tenders to be sent to the "Casa Capitular," Almeria, for the public lighting of the outer suburbs of that town by means of 400 electric lamps of 5 C.P. The annual rental payable by the municipality is 11,600 pesetas (about £419), or such lower figure as the competition may elicit. A provisional deposit of 580 pesetas (about £20) is required to qualify any tender. Local representation is necessary.—*Board of Trade Journal.*

CLOSED.

Bolton.—The Electricity Committee of the T.C. has accepted the tender of the Triumph Stoker Co., Ltd., for the supply of two Triumph stokers, and that of the British Insulated & Helsby Cables, Ltd., for the supply of cables.

Croydon.—The T.C. has accepted the tender of Mr. E. J. Saunders for the construction of an underground sub-station at West Croydon, at £193.

Enfield.—The Secretary of State for War has accepted the tender of Messrs. Johnson & Phillips, Ltd., for supplying and erecting cables and boxes at the Royal Small Arms Factory, Enfield Lock.

Grimsby.—Messrs. Crompton & Co., Ltd., have just received a further order from the Great Central Railway for six electric railway capstans for the docks at Grimsby.

G.W. Railway.—The Great Western Railway have placed their contract for electric lamps for the ensuing 12 months with Cryselco, Ltd., of Bedford.

Halifax.—The T.C. has accepted the tender of Mr. Richard Turner for the supply of 11 tramcar roof covers.

Plumstead.—The B.C. has accepted the tender of Messrs. Grant & Taylor for installing the E.L. in the new fire station, at £141.

Walthamstow.—The U.D.C. has accepted the following tenders:—

White, Jacoby & Co.—Stripping and rewinding armature, £79.
British Westinghouse Co.—Two cylinders for engine at generating station, £80.
Gwynne's Ltd.—3-in. centrifugal pump at generating station, £34.
Tudor Accumulator Co.—Maintaining battery at sanatorium for ten years, £28 per annum.

West Bromwich.—A contract with the Tudor Accumulator Co., Ltd., for the repair and maintenance of the Corporation battery for ten years has been sealed.

Wigan.—The Corporation Electric Light and Tramways Committee has accepted the following tenders for the ensuing year:—

British Westinghouse Co., Ltd., Hurst, Nelson & Co., Ltd., and Dick, Kerr and Co., Ltd.—Tramcar accessories.
Bayley Steel Works, Ltd.—Tires.
Universal Mill Furnishing Co., and L. Andrew & Co.—Rubber goods.
Thompson & Co., Tickle Bros., and Park & Co.—Iron and steel.
John Wood & Sons, and Tickle Bros.—Iron castings.
Christopher & Co.—Malleable iron castings.
Mr. W. H. Baker, and Mr. Roger Bolton.—Brass castings.
Malleable Steel Castings Co., Ltd.—Steel castings.
General Electric Co., Ltd.—Robertson lamps.
Universal Mill Furnishing Co., Ltd.—A.E.G. lamps.
Cryselco, Ltd.—Cryselco lamps.
British Insulated & Helsby Cables, Ltd.—Paper-insulated cables, and lead-covered concentric cables.
Callender's Cable Co., Ltd.—Lead-covered twin cable.
W. T. Glover & Co., Ltd.—Rubber-insulated cables, rubber-insulated lead-covered cable, double cotton armature wire, armature binding wire, telephone wire, and three-core rubber telephone cable.
General Electric Co., Ltd.—Telephones, workshop flexible and cotton and silk covered flexible twin wires.
Estler Bros., and Watlington & Co.—Overhead materials.
H. C. Mayer & Co.—Electrical accessories.
Amalgamated Dry Batteries, Ltd.—Batteries.
Le Carbone, and the General Electric Co., Ltd.—General accessories.
D. Grundy & Co.—Asbestos.
Mr. Thos. Tyldesley.—Gauge glasses.
W. H. Wilcox & Co.—General stores.

Worcester.—The City Council has accepted the tender of the Electric Construction Co., Ltd., for two 300-360-KW. alternators with Belliss & Morcom engines, &c., for Hylton Road generating station, at £4,134.

FORTHCOMING EVENTS.

To-day's Events (Friday, December 7th).—Northampton Institute Engineering Society. Visit to Robertson's Electric Lamp Works, Hammersmith.
At 7 p.m. N.E. Coast Institution of Engineers and Shipbuilders. Dinner at the Westgate Assembly Rooms, Newcastle.

Saturday, December 8th.—At 10 a.m. Institution of Electrical Engineers (Students). Visit to the North London Railway Works, Bow.
At 2 p.m. North of England Institute of Mining and Mechanical Engineers. Meeting.
At 3 p.m. Junior Institution of Engineers. Visit.
At 2 p.m. North of England Institute of Mining and Mechanical Engineers. Meeting at Newcastle. Papers to be read and discussed:—"Practical Problems of Machine Mining," by Mr. S. Mavor; "A Rateau Exhaust-Steam-Driven Three-phase Haulage Plant," by Mr. W. Maurice; "Liquid Air and its Use in Rescue Apparatus," by Mr. O. Simonis.
Monday, December 10th.—At 8 p.m. Institution of Electrical Engineers (Newcastle). Mr. J. S. Barnes on "Three-phase Alternating Currents."
Institution of Mechanical Engineers (Graduates). "Up-to-date Milling Machines," by Mr. A. B. Symons.
At 7.30 p.m. Society of Engineers. Annual general meeting.
Institute of Marine Engineers. Mr. A. E. Battle on "Electricity."
Tuesday, December 11th.—At 8 p.m. Faraday Society. Dr. A. C. C. Cumming on "The Electro-Chemistry of Lead" and "Contributions to the Study of Strong Electrolytes"; Mr. R. W. Vicarey on "Storage Batteries and their Electrolytes." (Part II.)
At 8 p.m. Institution of Electrical Engineers (Glasgow). Meeting.
Institution of Civil Engineers. After another paper, if time permits:—"Mechanical Considerations in the Design of High Tension Switchgear," by Mr. H. W. E. Le Fanu.
Wednesday, December 12th.—At 7.30 p.m. Institution of Electrical Engineers (Birmingham). Mr. G. A. Lister on the "Heating of Magnet Coils."
At 8 p.m. Association of Engineers-in-Charge. Meeting.
Thursday, December 13th.—At 7.15 p.m. Institution of Electrical Engineers (Leeds). "Practical Photometry and its Value," with Practical demonstration by Mr. H. H. Harrison.
Friday, December 14th.—At 7 p.m. Physical Society. Second Annual Exhibition of Electrical, Optical and other Physical Apparatus. At Royal College of Science, S.W.
At 7.30 p.m. Institution of Electrical Engineers (Manchester). Mr. P. Lobel on "Design of Central Stations."
Northampton Institute Engineering Society. "Modern Common Battery Telephone Exchanges." By Mr. H. Cross.
At 8 p.m. Electro-Harmonic Society Smoking Concert at Holborn Restaurant. Further particulars in our "Notes" columns.
At 8 p.m. Institution of Mechanical Engineers. Meeting.

Production of Graphite in the U.S.A.—The quantity of graphite produced in the United States in 1905 showed a considerable increase; in the States of New York and Pennsylvania, 2,741 tons (2,200 lb.) of crystalline graphite were extracted, of a total value of £47,514. The price varied from 1·6d. to 3·75d. per lb. Amorphous graphite derived from various States amounted to 21,953 tons, worth £16,128. The price varied from 5s. to £20 per ton. During the year 17,457 tons were imported, having a value of £196,607. Artificial graphite was made to the extent of 2,085 tons, worth £62,796.

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

THE following orders are issued:—

Monday, December 10th.—"A" Company, recruits' infantry drill, 6 p.m.; Hopkinson Cup competition, 7 p.m.
Tuesday, December 11th.—"B" Company, Hopkinson Cup competition, 7 p.m.
Thursday, December 13th.—"C" Company, Hopkinson Cup competition, 7 p.m.
Friday, December 14th.—"D" Company, Hopkinson Cup competition, 7 p.m.
Saturday, December 15th.—Corps Dinner, 7.30 p.m., for 8 p.m., at the Criterion Restaurant, Jermyn Street.

J. H. S. PHILLIPS, Captain,
For O.C.E.E.R.E. (V.).

NOTES.

Tests of a Zoelly Turbine.—A series of tests on a Zoelly turbine of 1,500 KW. at 1,500 R.P.M., made by the Société Alsacienne de Constructions Mécaniques, of Mulhouse, and coupled to a Siemens-Schuckert three-phase alternator, is given in *l'Industrie Electrique*. The steam pressure was 170 lb. per sq. in., and the steam temperature 572° F. The results are given below:—

—	A.	B.	C.	D.	E. No-load.
Duration of test, minutes	55·5	42·5	56·0	83·0	35·0
Gross power output KW.	390·2	551·2	1,269·0	1,628·5	18·0
Power absorbed by condensing plant, KW.	18	19	19	19	18
Net power, KW. ...	372·2	532·2	1,250·0	1,609·5	0
Percentage of normal full-load	24·7	35·4	83·3	107·3	0
Power-factor	0·955	0·9775	0·887	0·91	—
Speed, R.P.M.	1,492	1,498	1,498	1,483	—
Pressure at stop valve, kg./cm.²	11·42	10·76	11·36	11·24	11·51
Superheat, deg. C. ...	64·1	50·3	55·5	74·4	50·1
Vacuum, per cent. of barometric pressure	95·0	94·6	94·0	95·0	95·0
Total consumption of steam, kg. per hour	3,922	5,445	10,524	12,812	912
Steam per KW.-hour of useful load, kg. ...	10·537	10·231	8·419	7·960	—
Steam per KW.-hour of useful load, lb. ...	23·2	22·6	18·6	17·5	—
Calories per KW.-hour of useful load ...	7,424	7,131	5,893	5,652	—

Royal College of Science Bursaries.—A number of science scholars at the Royal College of Science, who prosecute their studies and maintain themselves on the small allowance of 17s. 9d. per week, have been materially assisted by secret gifts of small bursaries, thanks to the kind offices of Prof. J. Perry, who, we believe, devotes the royalties on his patent slide rules to this worthy object. We have received the balance-sheet of the Bursary Fund for 1905-6, audited by Prof. Tilden, from which we learn that bursaries to the amount of £252 were thus distributed. The subscribers include Dr. Sprague, Messrs. A. T. Simmons, O. Guttman, R. Kaye Gray, M. W. Gray, G. Beilby, and the Drapers' and Goldsmiths' Companies, besides the log-log rule. It is understood that every student in receipt of these aids is morally bound to repay the money to the fund at some future time. We commend this admirable scheme to the attention of the many philanthropic members of the electrical industries; they may be sure that in this case their contributions will be applied with the highest efficiency and the maximum of usefulness.

A Tall Story.—A correspondent recently favoured us with the following extract from the lay Press:—

"John Stranahan, the son of a prosperous ranchman, by flying box-kites from the very high peaks known as Sully Buttes, and allowing the kites to rise several thousand feet, is able to collect from the air and store in a device strung between the kites sufficient Hertzian waves to light the entire ranch and run a small pumping station and traction engine. Stranahan studied at an Eastern polytechnic school, and experimented with his kites for six months before obtaining practical results.—*Laffan.*"

To do the *Daily Telegraph* justice, it used the heading given above.

Another gem of romance comes from Quebec, where, we are told, a young plumber, who cannot read or write, has succeeded in devising a machine, by means of which sufficient electric current can be generated to light and heat any building, from the ground directly underneath, at a ridiculously small annual cost. This sounds awkward for the Zambesi scheme.

(*Continued on page* 921.)

THE SNOWDON HYDRO-ELECTRIC INSTALLATION OF THE NORTH WALES POWER AND TRACTION CO., Ltd.

Unlike our Continental and American friends, we in Britain have few natural water-powers which offer facilities for commercial development on any extended scale. A noteworthy exception, however, must be made in the case of the North Wales Power Co., whose undertaking it is our purpose to describe in this and subsequent issues.

This hydro-electrical plant, situated as it is on the eastern slope of Snowdon, amongst the wildest and most rugged of Welsh scenery, has a charm and interest far beyond that which attaches to the usual run of electrical work in this country. The feasibility of carrying out such an undertaking was, we believe, originally mooted by a well-known engineer, at present located in the Colonies, who, during the course of a holiday tour in the neighbourhood, was much impressed by the potential possibilities of the two small lakes, Glas-Lyn and Llyn Llydaw, situated in a declivity about half-way up the eastern side of Snowdon.

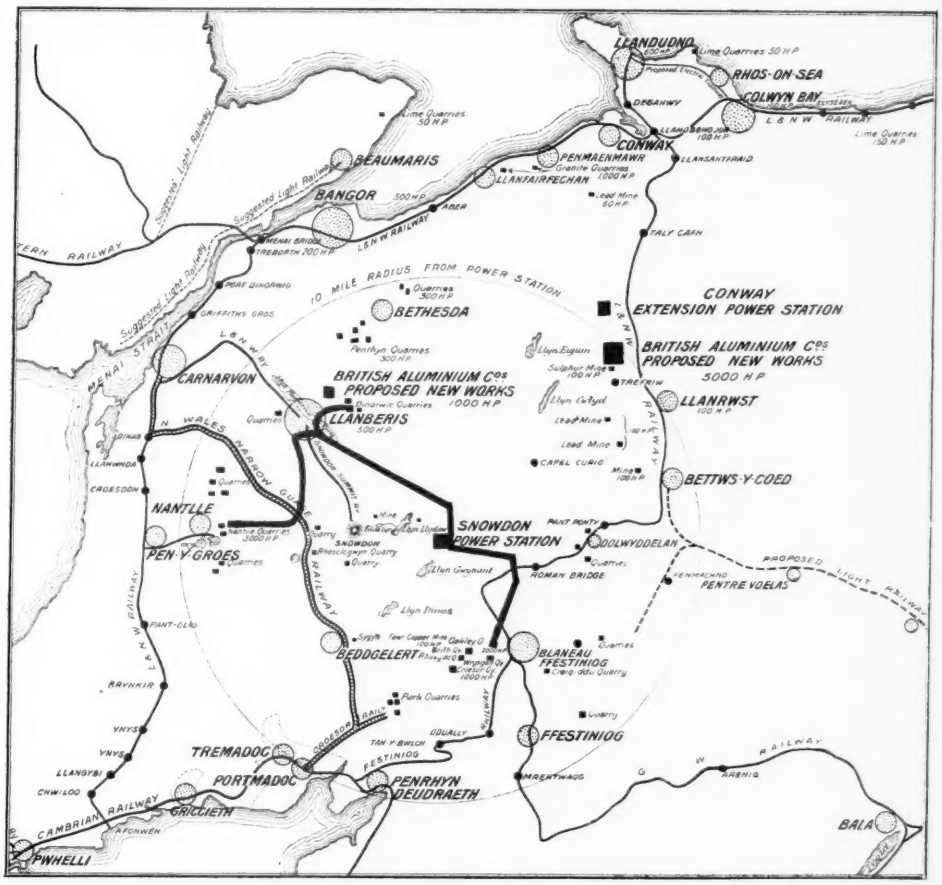


Fig. 1.—Plan of the North Wales Power Co.'s Area, Showing the 10,000-volt Transmission Routes.

Fig. 2.—Pipe Line and Anchorage; Power Station Below.

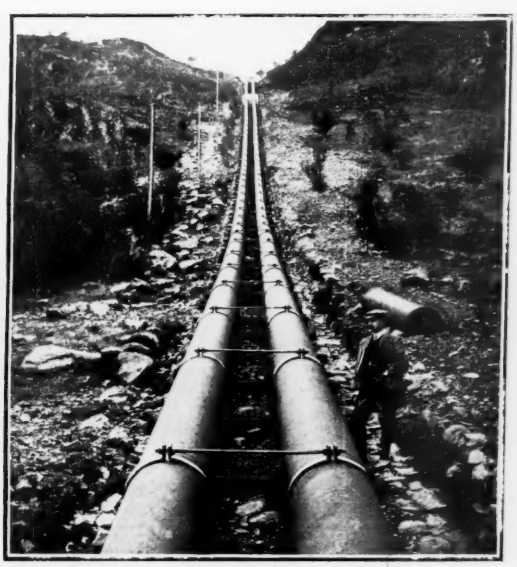


Fig. 3.—Upper Section of Pipe Line.

The scheme, which has been carried out for the company above-named, utilises the 1,100 ft. drop from these lakes into

the valley below, where a power station has been built, and includes a series of H.T. transmissions, which pass over the mountains and supply energy to the very extensive slate quarries for which North Wales is famous.

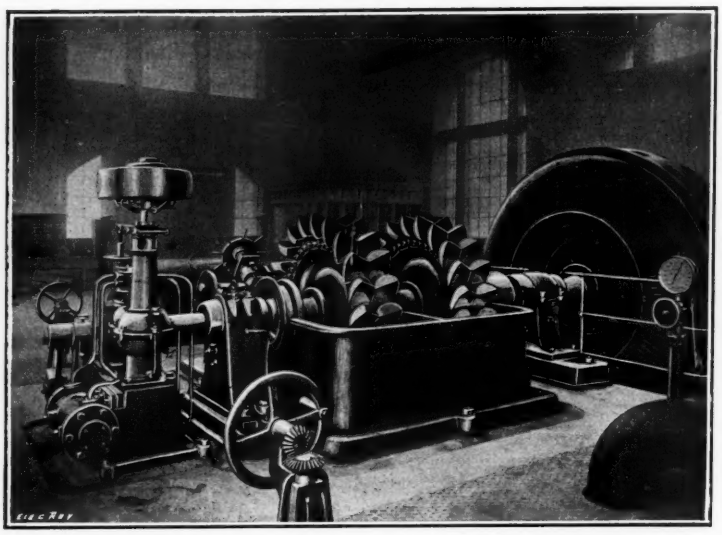


Fig. 4.—Twin Pelton Wheel Unit, with Wheel Cover Removed, Showing also Hydraulic Governor Gear to the Left.

But as an electric railway, to jointly benefit the quarry owner and tourist, is progressing towards completion, and many much-needed electric lighting schemes are on foot, prospects of development in other directions are very promising. The consulting engineers for the scheme were Sir Douglas Fox & Partners and Messrs. Harper Bros., and the whole of the work has been carried out by the well-known engineering firm of Bruce Peebles & Co., Ltd., of Edinburgh and London.

Returning to the engineering features of the scheme, reference must, in the first place, be made to civil engineering matters, which, excepting for the difficulties naturally met with in carrying out such work in a wild country, are not of a particularly complex nature.

Llyn Llydaw, from which the water supply is drawn, and from which the pipe line descends to the power house—occupies a declivity on the mountain side, almost immediately above the head of the better known, and more easily seen, Llyn Gwynant in the valley below.

The surface of the former lake, 120 acres in extent, is approximately 1,400 ft. above the sea level, and the intake works consist merely of a 6-ft. dia. tunnel on a gradient of 1 in 152—which pierces the few hundred feet of rock forming the margin of the lake on the mountain side—terminating in a duplicate pipe line.

The inlet to the tunnel, 30 ft. below the lake's surface, is controlled by two 48-in. sluice valves, worked from a gantry above, and accessible through, a vertical shaft, built in concrete. The fact that the pipe line is roughly only $1\frac{1}{4}$ miles long and gives an effective head at the power station of 1,140 ft. indicates its abrupt descent; the section immediately above the power house runs at an angle of 45° to the vertical. Each of the duplicate pipes tapers from 30 in. diameter at the top, to 27 in. diameter at the bottom; the thickness of metal employed varies, of course, according to the head of water, being $\frac{5}{16}$ in. for the upper sections where riveted steel is employed, and $\frac{3}{4}$ in. at the bottom

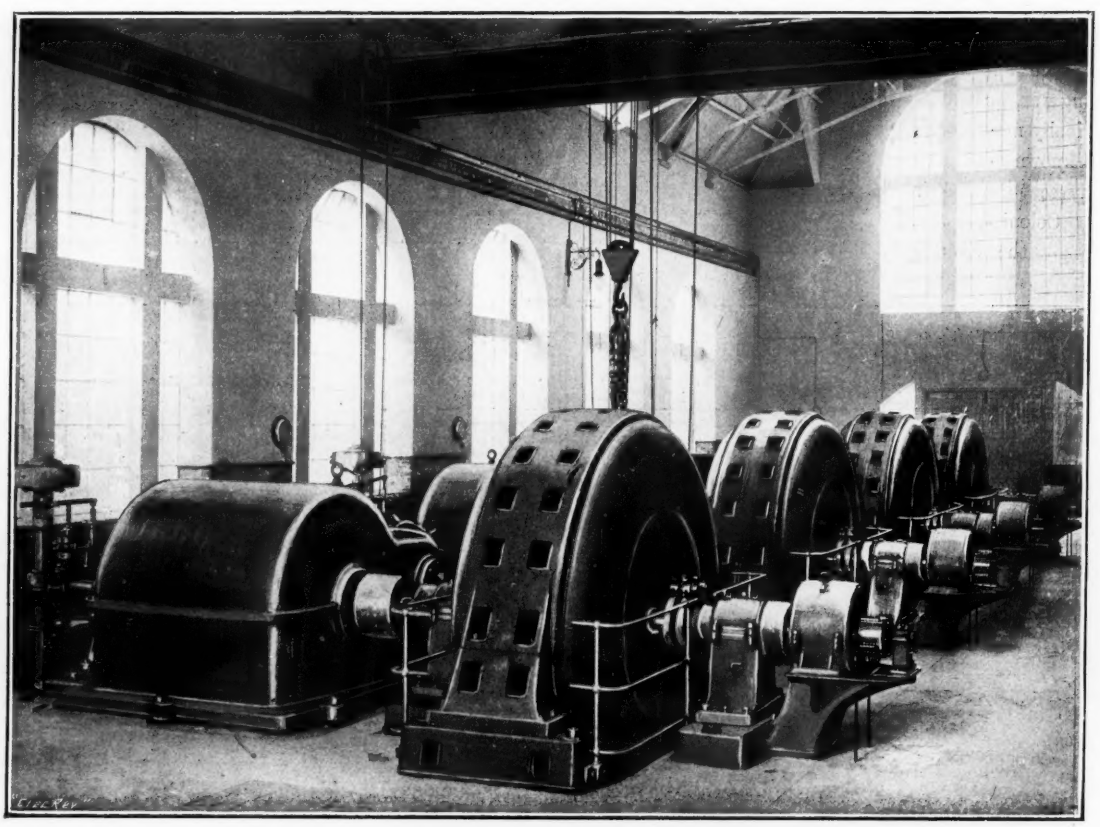


Fig. 5.—View of Peebles 1,500 K.V.A. 10,000-Volt Three-phase Alternators and Station Plant.

where welded steel spigot and fawcet pipes with lead caulked joints are used.

The pipes are approximately in 18 ft. lengths, laid on 10 in. × 7 in. wood sleepers, each 10 ft. long and spaced at about 8 ft. intervals; each pipe length is clamped on to an anchor tee underneath and stayed to its neighbour in the other pipe line, the tees being sunk side by side in a concrete anchor block some 8 ft. × 3 ft. × 4 ft. 6 in. deep, embedded in the pipe track. Weightier anchors, containing up to 150 tons of concrete, are used where bends occur in the pipe route. The clamps above tween the clamp and joint, any tendency of the lead jointing material to creep can be easily checked.

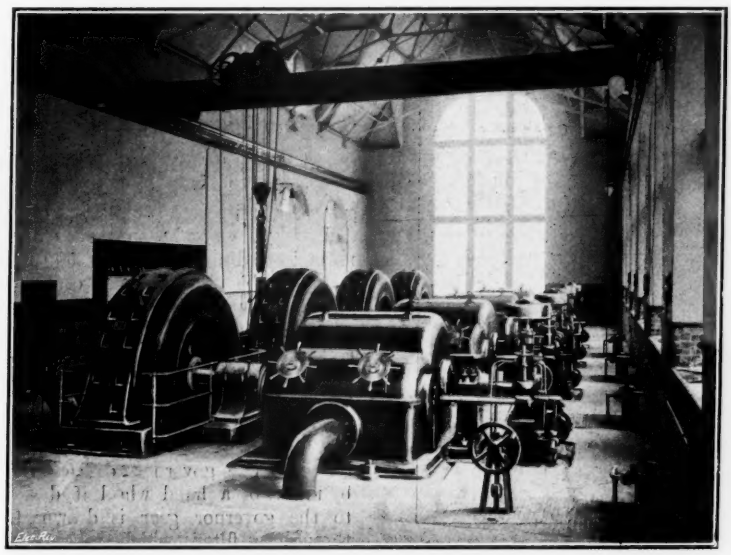
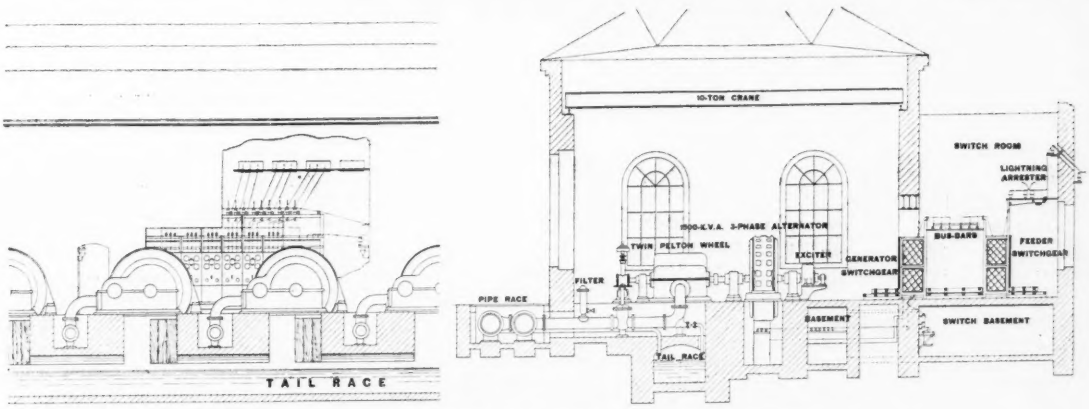


Fig. 6.—General View of Pelton Wheels and Station.

As a further precaution, to check any creeping in the pipe lines themselves, measured distances have been provided to fixed points on the side of the pipe route.

Very great difficulty was experienced in connection with the transport of the heavy material for the pipe line, as will be gathered from figs. 2 and 3; the pipes, sleepers, ballast, concrete, &c., having all to be hauled to position.

In order to execute this work, it was



Figs. 7 and 8.—Sectional Elevations of the Power Station.

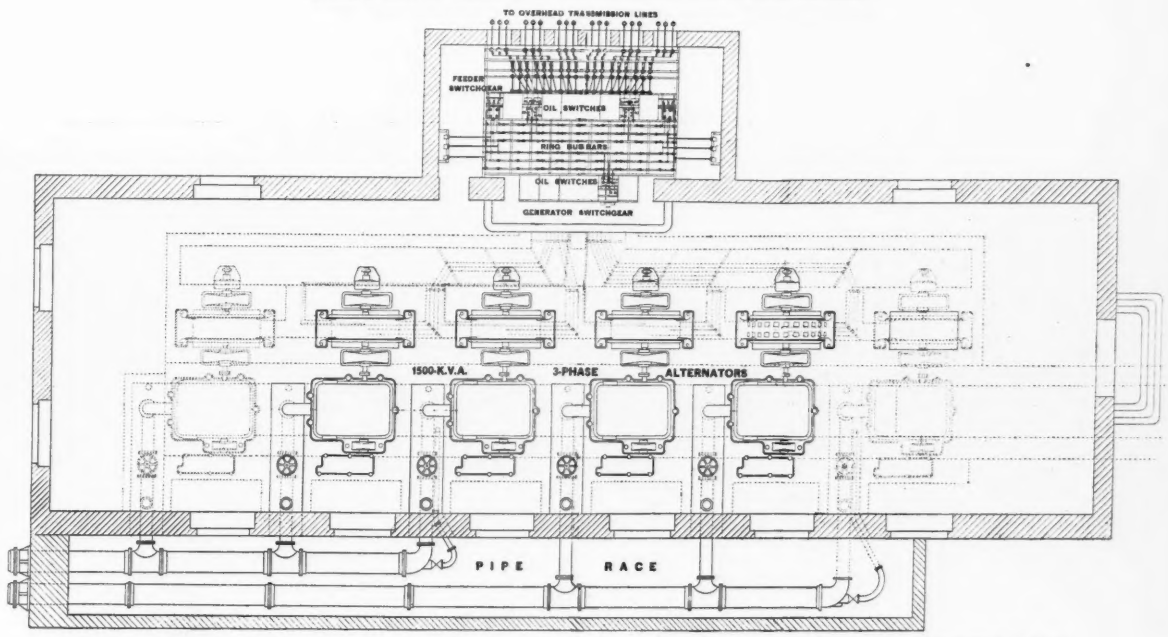


Fig. 9.—Plan of the Power Station, Showing the Arrangement of Pipes, Turbines and Electrical Plant.

mentioned are arranged immediately in front of the pipe joints, where, by inserting a small packing ring be- necessary to construct several incline haulages, and it is a matter for congratulation that the work was carried

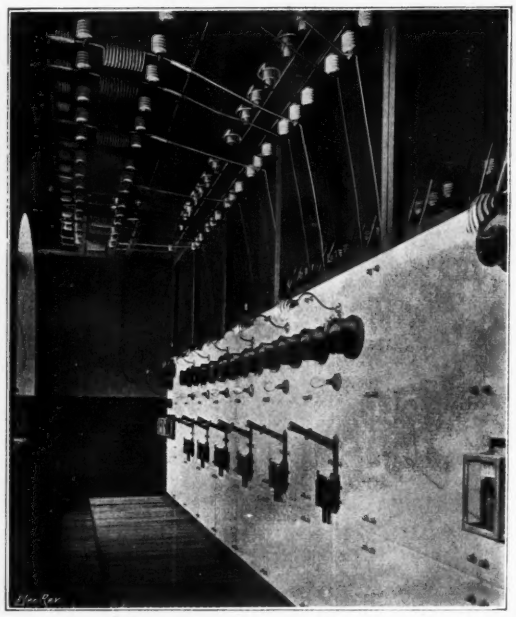


Fig. 10.—H.T. Switchgear; the Feeder Panels.

out under the most difficult climatic conditions without accident.

The pipe line terminates in a pipe race adjoining the station building. A Blakeborough sluice valve, with by-pass, is provided to each line for isolating purposes, air cocks for preventing water hammer action, and valves for draining the pipes are also fitted.

Either pipe line would supply the normal station load, when its full plant equipment is provided, and this for a period of 180 days total drought, assuming normal conditions to exist at the commencement of the period. But shortage of water is not anticipated, as the rainfall during the past year fell little short of 200 in.

The power house building, fig. 2, stands on the bank of a small stream, which, in fact, carries away the overflow from Llyn Llydaw upon the mountain side, and is joined lower down by the tail race discharge from the power house, prior to entering Llyn Gwynant. It is substantially constructed of local stone picked out with brickwork, and is provided with a high pitched roof with overhanging eaves as a protection against snow. Its dimensions are also ample although naturally dwarfed by the grandeur of the surroundings, being about 145 ft. × 45 ft. wide, and 50 ft. high.

The whole of the foundation work for the building, together with the tail race, pipe trenches, basements, &c., are formed in concrete.

At present four 1,500-H.P. twin Pelton wheels, coupled direct to three-phase Bruce Peebles alternators, are installed, arranged as shown in figs. 7, 8 and 9, and two additional units can be added when required.

Each hydraulic unit is fed through a 12-in. branch pipe, which, entering the building from the pipe race outside, passes through a starting valve and into the wheel case, where it connects to two needle regulating nozzles feeding the wheels. The water pressure, due to its 1,140 ft. head, is practically 500 lb. per sq. in. at the nozzles.

The wheels themselves are of normal design, with cast-steel buckets bolted to the periphery of a turned steel disk and accurately balanced when fitted up. A hydraulic governor is fitted to each unit, which regulates the speed by deflecting the nozzles to some extent off the buckets; the normal speed of the wheels is 500 R.P.M., and their efficiency stated to be about 80 per cent.: the speed regulation is within 4 per cent.

Fig. 4 shows clearly the arrangement of Pelton wheels and governor gear of a single unit: the governor—of the weighted type—actuates a small auxiliary valve for controlling the movement of the piston in a hydraulic cylinder (seen at the foot of the governor), the piston movement being communicated to the nozzles by means of a simple system of levers. The governor deflections can be supplemented by means of a hand wheel if desired. The water supply to the governor gear is drawn from the main supply through a filter, which takes out any sand or organic matter; the filters can be seen to the right in fig. 6.

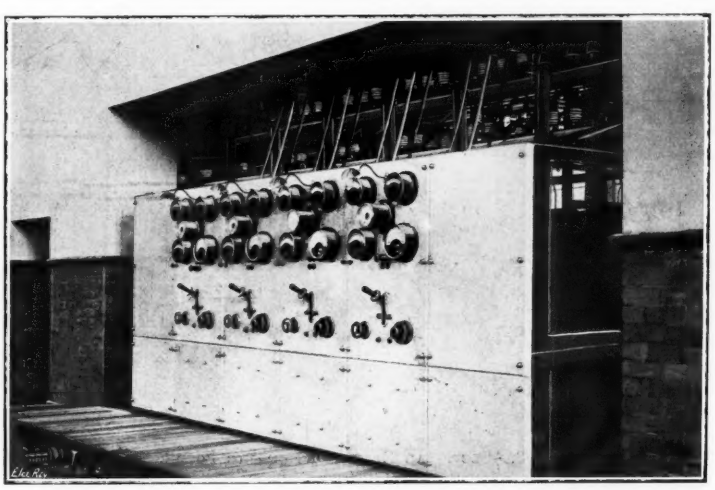


Fig. 11.—H.T. Switchgear; the Generator Panels.

The wheel discharge, and that from the nozzles (at 500 lb. per sq. in.) when deflected, strikes against a cast-iron baffle plate with a backing of timber, subsequently falling into a pool of water in the tail race. Owing to the destructive effects of the discharge, even after rebounding from the baffle plate, the idea of forming a pool of water in the tail race to protect the concrete floor was resorted to and has proved very successful.

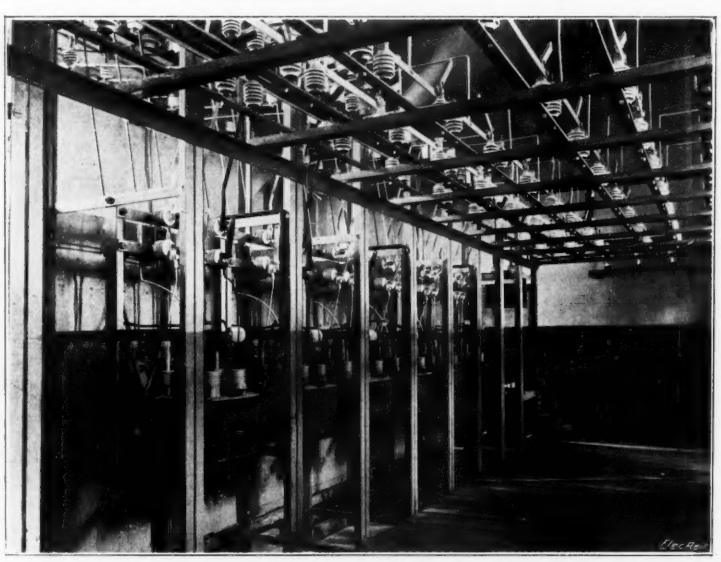


Fig. 12.—H.T. Switchgear; Showing the Arrangement behind the Panels, Oil Switches, Overhead Bus-bars, &c.

The alternators are of the Peebles revolving field type each with 12 poles and a rated output of 1,500 K.V.A. at a pressure of 10,000 volts and 50 cycles; a small four-pole 45-volt exciter is mounted on an extension of each alternator shaft, as shown in our view, fig. 5, which gives a good idea of the generator proportions.

In regard to the electrical details of the alternators, the stator windings are of insulated copper strip, eight strips being wound edgewise in each slot and insulated with mica. The slots, of which there are 144—four per pole per phase—are of the semi-enclosed type, formed in a laminated soft iron core provided with ample ventilating spaces; the windings where they project from the core are protected by perforated shields bolted to either side of the stator carcase.

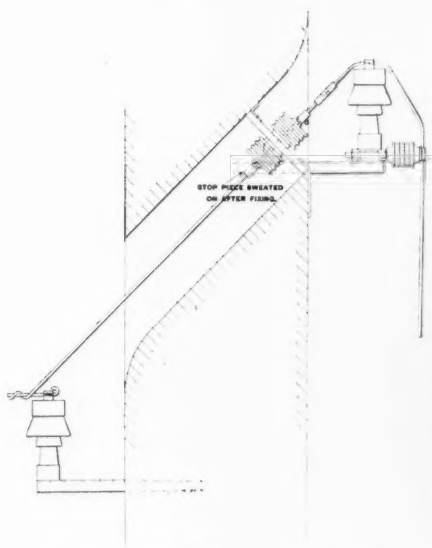


Fig. 13.—Showing Method of Leading out Feeders from Switch Room.

Fig. 14.—Straining Frame outside Switch Room; Starting Point of Overhead Transmissions.

The magnet poles are of steel, cast solid with a steel magnet ring shrunk on to a cast-iron yoke, the latter being pressed and keyed on to the shaft and further secured by rings shrunk on to the boss. The pole tips are of cast-steel tapered towards the edges with a view to ensuring correct electrical characteristics, and the pole windings of copper strip on edge. The air-gap in these machines is $\frac{5}{16}$ in; they are star connected with earthed neutrals and were tested to 18,000 volts at Messrs. Bruce Peebles' works.

The three large bearings which support the heavy rotating parts are all water cooled and of the self-aligning type, with white metal linings, and ring lubrication: the couplings are also cased in.

A 10-ton hand crane, supplied by Carrick & Sons, Edinburgh, which spans the building, facilitates the carrying out of repairs, &c. Switchgear of a very simple character is located in a switchroom adjoining the main building and opening into it. Practically, it consists of a rectangular steel bar cage, with switch panels on two opposite sides and protective wire grillages on the other two. The panels are of white marble; six machine panels, four of which are equipped, face on to the generators; the remaining panels—six feeders, two spares and two summation panels—face the outer wall of the switchroom; this is out of sight, of course, from the main building, but not out of mind, for as it happens, very effective means has been taken to draw attention when necessary, as will be shown.

The switch equipment was sub-contracted to Messrs.

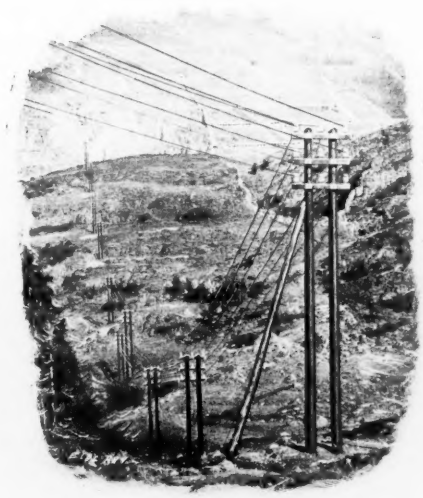
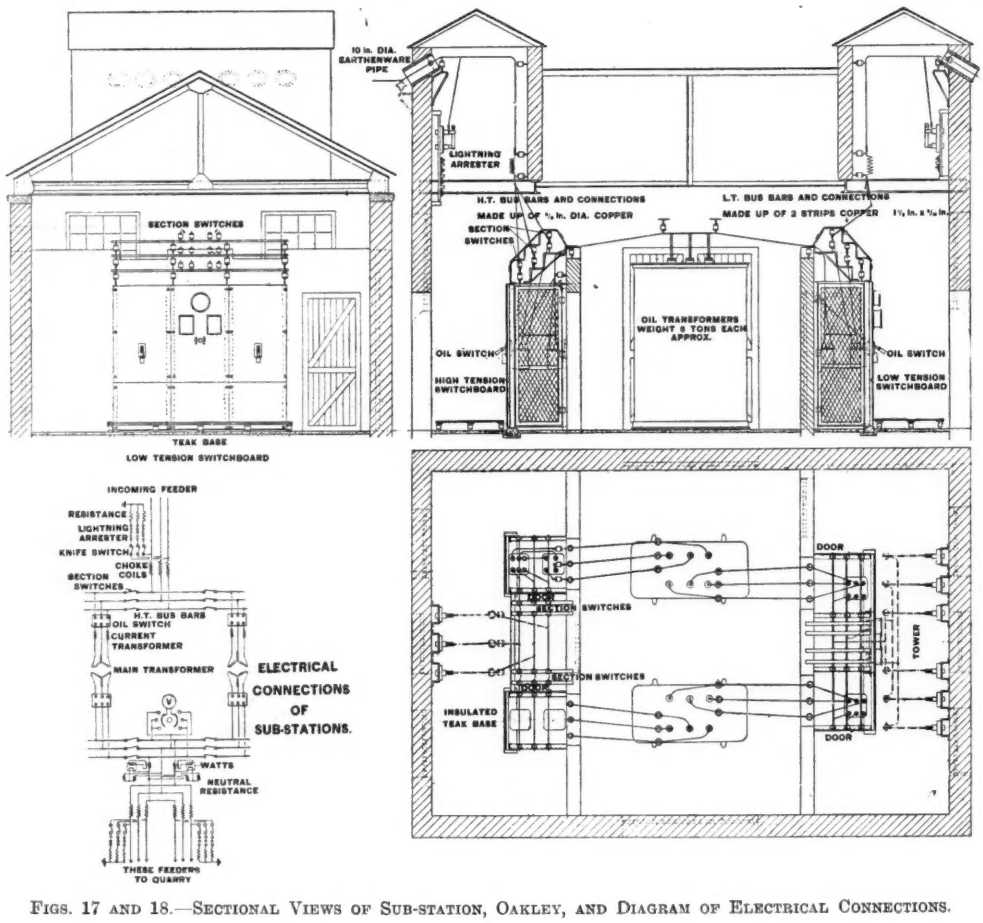


Fig. 15.—Transmission Line, Wooden Poles; showing Dinorwic Quarry in the Background.

Fig. 16.—Transmission Line, Lattice Poles with Road Cradle; Llanberis Pass.



Figs. 17 and 18.—Sectional Views of Sub-station, Oakley, and Diagram of Electrical Connections.

Ferranti; the generator panels, fig. 11, contain the operating handle of the main oil switch, with triple overload trip coils mounted below; five circular type instruments on the upper part, *i.e.*:—ammeter, voltmeter, wattmeter, exciter and synchronising voltmeters, and field switches on the lower part.

The feeder board consists of ten panels, six being for feeders, two spare, and the two end ones, summation panels. The feeder panels, fig. 10, contain the handle of the feeder oil switch with the overload trip coils below, and two ammeters and an indicating lamp above; the summation panels are equipped with two ammeters and a voltmeter, with a switch immediately under for giving the phase voltage, also two Ferranti integrating watt-hour meters.

Bare copper leads carried on porcelain insulators, run through the basement from the generators to the oil circuit-breakers, and from there lead up through isolating links to "ring" bus-bars, of 1 in. by ¼ in. copper, supported by porcelain insulators on the bar frame above. The feeder connections are taken from the opposite half of the "ring," the meters being interposed between the generator and feeder sections.

Isolating links are provided in the bus-bars between all feeder and generator connections, the arrangement behind the board being clearly shown in fig. 12. From the bus-bars the feeder connections pass, in much the same way, down to the feeder oil switches, which, however, are in this case fitted with an alarm bell in connection with the tripping coils, to warn the station attendant if a feeder happens to trip out.

From the oil switches the outgoing feeders rise above the board and pass through choking coils—in connection with horn lightning arresters just above—and down through a series of rectangular openings in the wall of the building, to a straining frame outside, which forms the starting point of the overhead transmission.

Fig. 10 is an excellent view of the feeder board, with the choke coils above, and together with the previous views,

Fig. 19.—Single Transmission Line to the Oakley Quarries Blaneau Festiniog; showing the Power Station, Pipe Line and Snowdon in the Background.

indicates the extremely simple and workmanlike construction employed by Messrs. Bruce Peebles in this connection.

All the instruments are, of course, energised through trans-

formers, the potential transformers being housed in the basement, and the current transformers in proximity to the oil switches behind the board, where also uralite screens are fitted between the upper portions of the panels.

In addition to the horn lightning arresters above mentioned, which are earthed on to the iron frame of the board, permanent water-type excess-pressure discharges are installed, one at either end of the switch room, where connection is made to the bus-bars.

The station plant, together with the switchboard framework, is earthed on to a structure built up of copper sheets bolted to a copper frame, which is sunk in the bed of the adjacent stream.

Wherever the switchgear is accessible from the floor, wooden platforms, supported on porcelain insulators, are provided, this being in addition to the usual rubber mats provided in such situations: and all the conductors and bus-bars, are distinctly coloured in red, white and blue.

Both arc and incandescent lighting are provided in the station, fed from a 20-KW. lighting transformer; it is, however, proposed to put down a small D.C. turbo-generator, as an alternative source of supply, and an auxiliary board which controls the lighting circuits is suitably equipped for running the latter from either source of energy.

Needless to add, telephonic communication is provided along all the transmission lines, and up to the intake of the pipe line; the instruments are of a special pattern, by Deckert and Homolka, of Prague, and are designed to prevent the possibility of shock to the user.

The only buildings in the vicinity of the station are the station superintendent's residence and engineers' bungalows, which are constructed in wood and corrugated iron.

In concluding our reference to this portion of the work, lack of space precludes any lengthy mention of the obvious difficulties met with in carrying it out. Some idea of their extent may be gathered from the fact that three traction engines and numerous horse haulages were employed in bringing up the heavy loads through the well known Llanberis Pass from Llanberis Station, some eight miles distant, that new roads, tramroads, inclines, with winch haulage and mule teams were all called upon to take a share in the transportation of the machinery, pipes, poles, cement, &c., and that over 800 men were employed on this section of the work alone, in addition to hundreds of others engaged upon the transmission lines, &c.

FIG. 20.—SUB-STATION AT PENYBORSEDD QUARRY, SHOWING THE INCOMING H.T. AND OUTGOING L.T. FEEDERS.

The overhead transmission lines, as previously stated, start from a terminal frame outside the switch room; the outgoing feeders passing down inclined ports in the wall, where they are supported in porcelain leading-in insulators, fixed in paraffined-board partitions, as shown in fig. 13, and over insulators to the lines, which are shackled on to the bar frame, shown in fig. 14.

Altogether 26 miles of transmissions have been erected for the North Wales Co.; a reference to the map, fig. 1, will show the general lay-out of the routes taken.

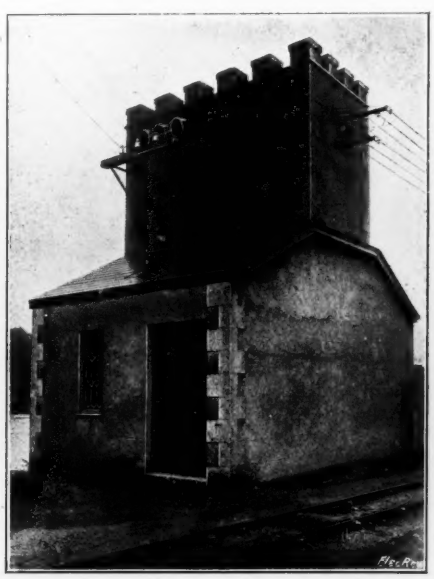


FIG. 21.—THE DINORWIC (LOWER) SUB-STATION.

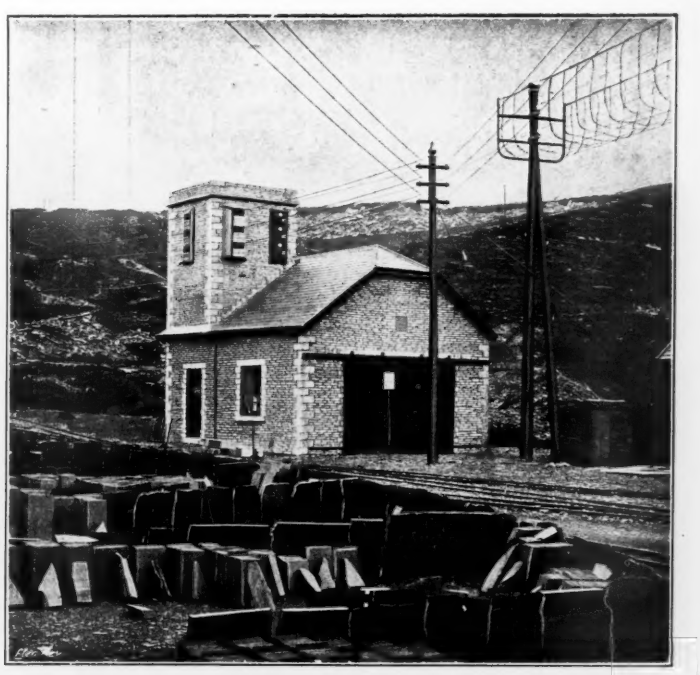


FIG. 22.—SUB-STATION IN LOWER QUARRY, OAKLEY, SHOWING OVERHEAD TRANSMISSIONS.

One three-phase line, consisting of three 8 mm. wires, makes a bee-line over the mountains in an easterly direction to a point near Roman Bridge, where it turns to the south, terminating at the Oakley Quarries, Blaneau Festiniog, a distance of 7 miles. The principal transmission, however, consisting of three three-phase lines, each consisting of 9 mm.

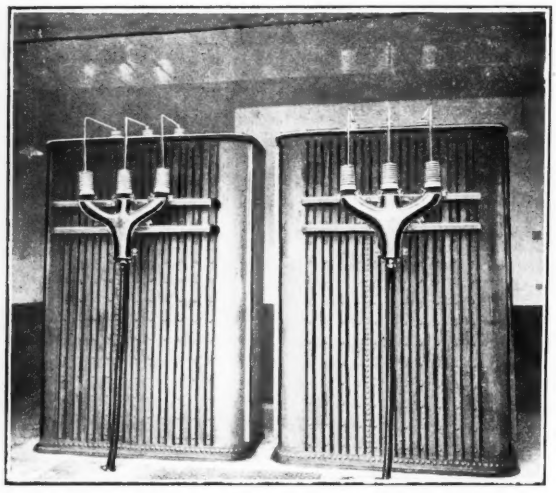


Fig. 23.—"Peebles" 500-kw. Oil-cooled Transformers, Oakley Sub-station Plant.

wires, turns north from the power station, subsequently passing in a westerly direction over the Llanberis Pass to a point near the Llanberis railway station, where a 6 mm. line branches off to the right, to Messrs. Asheton Smith's Dinorwic Quarries. The main transmission here turns to the south, climbing over the shoulder of Snowdon, some 2,300 ft. above the sea level, and dropping on the other side to Quellyn Lake, where it crosses the North Wales narrow gauge railway, a line which, with its extensions, will

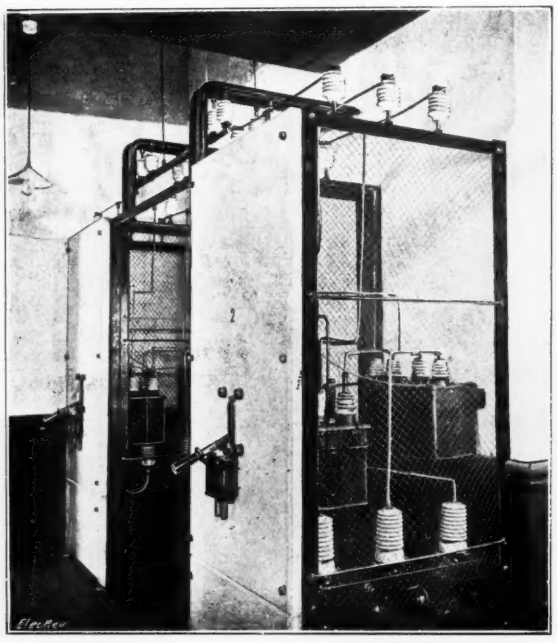


Fig. 24.—H.T. Switchgear at Sub-station, Oakley.

eventually be supplied with electrical power for operating purposes. From this point the transmission line turns westward, terminating at the Penyrorsedd Quarries, at Nantlle.

Various pole line constructions have been adopted in the carrying out of the work, according to circumstances; for the most part creosoted wooden poles are used, 7 in. to 9 in. diameter, sunk 6 ft. in concrete at the base, and spaced, on the average, at forty per mile. The wires are spaced 2 ft. apart and supported on triple shed insulators, $6\frac{1}{2}$ in. deep and $4\frac{1}{4}$ in. diameter, fixed by means of 1 in. diameter bolts to galvanised iron brackets, at the side of the pole in the case of single-pole lines, and bolted to 5 in. × 4 in. wooden cross arms where double-pole construction is employed: usually they run not less than 20 ft. above the ground and 26 ft. at all road crossings, the telephone wires being fixed 4 ft. 6 in. below the power line. At bends in the route, two insulators carry each wire on the pole, and guard stays are provided to catch any falling wire. A section of the principal route over the Llanberis Pass, where very severe weather conditions exist at certain seasons, is provided with steel lattice poles, each stayed at four points.

In cases where wire stays are employed, such as in long straight runs and for the lattice poles, globe strain insulators are inserted; and all poles exhibit a warning notice in both Welsh and English and are provided with a spiked collar as an additional deterrent to the over-curious. In addition to the lightning protective devices in the power station, arresters of the B.T.-H. pattern are provided every three miles on the transmissions, and the latter are transposed where necessary to prevent interference with the telephone circuits.

In all, five types of pole construction have been employed, of which fig. 19 illustrates the single line to Oakley, incidentally giving a good idea of the relative location of the power station in the valley and the pipe line which climbs three-quarters of the way to the summit of Snowdon, shown in the background; fig. 15 illustrates the principal double-pole line leading past Llanberis—the Dinorwic quarries being in the background: and fig. 16 shows the lattice pole construction in the Llanberis Pass, the road span here, and in similar positions, being protected by wire cradles underneath. The latter consist of 5 mm. galvanised steel wires strung between angle iron frames attached to the poles at either end of the span, and laced by cross wires of 3 mm. diameter, the arrangement being shown in the illustration.

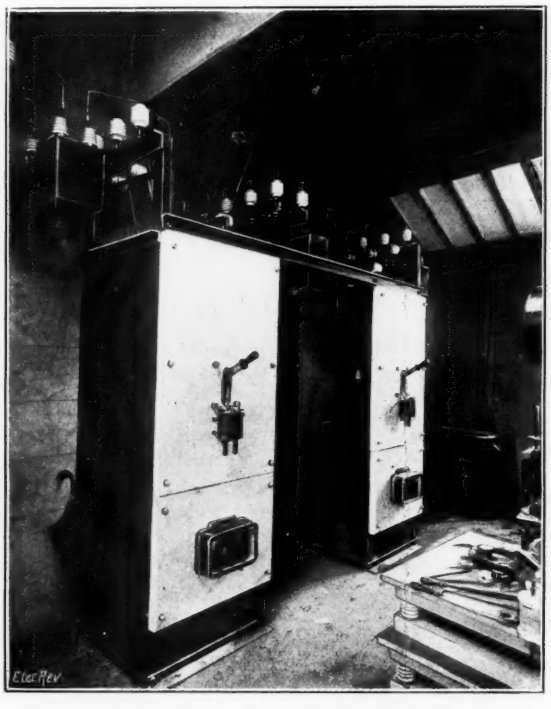


Fig. 25.—H.T. Panels, Dinorwic Lower Sub-station.

Drawings of the principal types of pole construction and of a 10,000-volt insulator and fixing are shown on page 919.

As in the construction of the power station, many difficulties were encountered in the pole line work, the latter, indeed, necessitating the laying down of temporary tramroads, of which some 10 miles were used, for hauling the

line material over the frequently boggy ground. On the other hand, a considerable amount of blasting was necessary, owing to rocky nature of the ground in certain parts, and under these circumstances the record of only two minor accidents, due to blasting, is a surprising one.

Mr. W. V. Waite, who represented Messrs. Bruce Peebles during the carrying out of the whole of the work, deserves all credit for the able manner in which his widely scattered

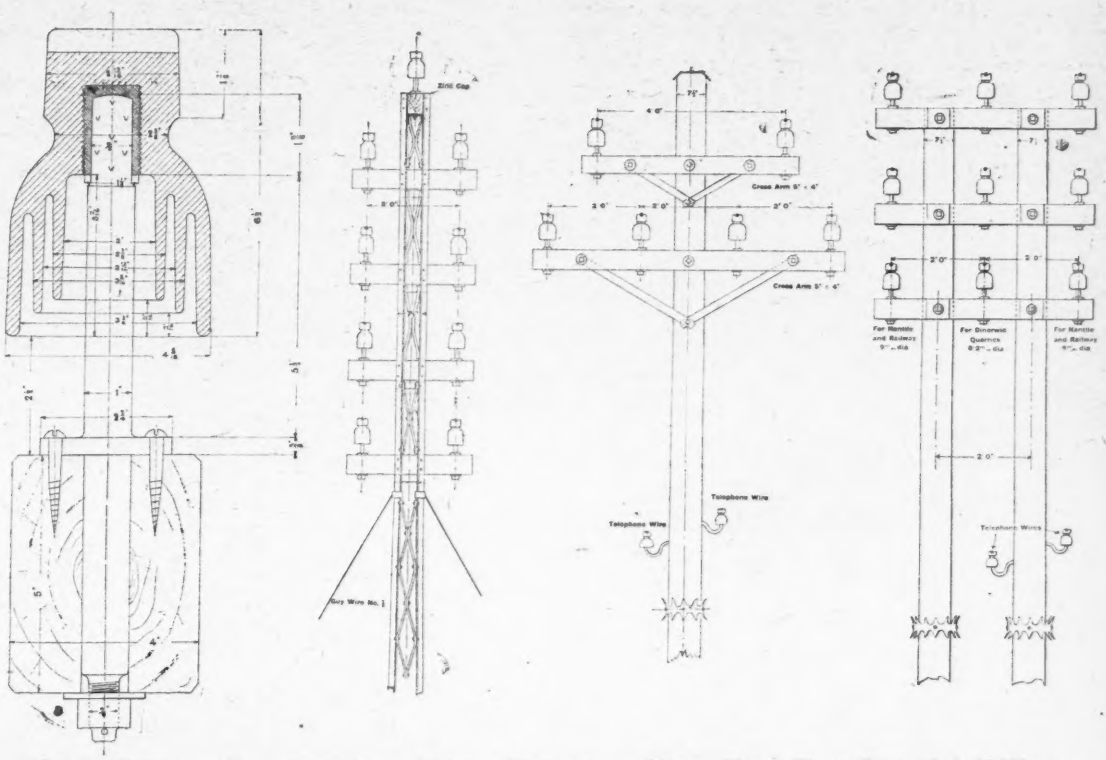


FIG. 26.—DETAILS OF POLE CONSTRUCTION, STANDARD INSULATOR AND FIXING; NORTH WALES POWER CO.'S 10,000-VOLT TRANSMISSIONS.

contract has been pulled through. Some idea of the subsidiary work involved may be gathered from the fact that 68 farmers—and these Welsh—had to be negotiated with in regard to wayleaves for the transmissions, the price of which worked out at a much lower figure than is usually expected.

No account of this undertaking can be considered complete without some reference to the utilisation of the power, and in the cases in point—the Welsh slate quarries—the installations are of a specially interesting character. The magnitude of the quarries, and the possibilities which they offer of extensive power contracts, will be matters of surprise to those unacquainted with the neighbourhood. Thus, although the initial supply—the company commenced operations early this year—only comprises the three quarries mentioned earlier, viz., Dinorwic, Penyrorsedd and Oakley, and these are by no means fully equipped, the power installed up to the present is 250 H.P., 750 H.P. and 1,900 H.P. respectively for the three undertakings.

Moreover, the district is studded with quarries and mines, many of which are situated on the present transmission routes, as will be gathered from the map of the district.

Curiously enough, the three undertakings mentioned above are representative of the three typical systems of slate quarrying in North Wales.

The Oakley Quarries at Blaneau Festiniog are very extensive, employing some 3,000 men, and comprise a series of underground workings to which access is obtained by inclined shafts, necessitating powerful haulages. From the Power Company's point of view they are most important, as a very complete equipment consisting of some 1,900 H.P. of motors is installed.

These comprise five 200-H.P. motors, which supplant the lately discarded steam engines for driving the haulages; two 150-H.P. motors for driving an air compressor and pump respectively, and a further motor of 60 H.P. for the latter purpose; a 40-H.P. and three 85-H.P. haulage motors; 23 15-H.P. motors for driving the sawing and trimming machinery in the mills; and a 10-H.P. motor in a repair shop. In addition there is about 10 KW. of underground lighting.

Two very similar transformer sub-stations have been built for supplying the Oakley requirements, the incoming transmission being divided at the quarry boundary, from which point a 6 mm. branch runs to each sub-station; either of the latter is capable of supplying the load, and in addition they are electrically linked together.

Figs. 17 and 18 will give a good idea of the lay-out of these buildings and the arrangements for securing absolute safety in operation.

(*To be concluded.*)

ELECTRIC POWER FOR THE RAND.

CRITICISM OF THE SCHEME BY MR. ROBERT HAMMOND.

THE following communication reached us too late for inclusion in our "Correspondence" columns, but in view of the importance of the subject at the moment, we insert it to prevent delay:—

It is exactly 12 months since the leading features of the scheme of the African Concessions Syndicate, for the utilisation of the Victoria Falls for the purpose of supplying the mining properties of the Witwatersrand with electric power, were made public.

At that time it was stated by one of the promoters that he was "absolutely satisfied that their scheme would be able to compete successfully with power produced from coal at any price," ½d. per unit being named as the price at which it would be possible to sell the energy to the users on the Rand, situated some 700 miles from the source of generation.

Two main points of criticism were made. In the first place, it was pointed out that the heavy cost of transmission would entirely nullify the cheapness attendant upon generating the electrical energy by water power. The transmission line was to be some 700 miles in length, passing through a wild unsettled country, and necessitating annually such heavy expense for patrolling and maintenance that the cost of the electrical energy delivered on the Rand would far exceed that at which it could be generated from coal on the spot.

In the second place, it was urged that the operations of the Rand Mines were such that any cessation of the supply of power to the mines would cause heavy financial losses, and that the mine-owners

would not be prepared to depend for their supply upon such a transmission line with its attendant risks of breakdown.

Twelve months have passed away, and the engineers of the Zambesi scheme have had full opportunity of considering and, if possible, of combating these criticisms. It is, therefore, somewhat surprising to find that in the manifesto issued by them last week not a single figure is produced to show that the criticisms of a year ago were ill-founded.

No information is vouchsafed as to the cost of the transmission line and as to the estimated annual expense of patrolling and maintaining it. Until very solid figures under each of these headings be forthcoming the criticisms of a year ago must be deemed to be standing in full force.

The manifesto gives prominence to the names of high scientific authorities, who, however, would hardly claim to be absolute authorities in commercial matters. Obviously, there are circumstances under which the transmission of a vast quantity of electricity for 700 miles might be scientifically possible but commercially unsound. Indeed, the man in the street, who is aware that by means of cables under the Atlantic electricity is conveyed for telegraphic purposes from London to New York, would be quite prepared readily to admit that a certain portion of the electrical energy delivered to the electric lines at Victoria Falls would make its appearance in Johannesburg, though the route traversed reached a length of 700 miles.

Practical engineers who desire to confine the scientists' opinions within the bounds of commercial possibility must check all such transmission schemes by a comparison of the cost of the electricity delivered from a distance with that of electricity produced on the spot. Much use is made by the British South Africa Co. of the example afforded by the Niagara Falls, but the illustration is a faulty one, since over 80 per cent. of the electrical energy produced at Niagara Falls is utilised within easy distance of the works. If, *nolens volens*, it be a sound proposition that wherever extensive water power is available, electrical energy can be delivered economically to a distance of 700 miles, I venture to ask the pertinent question why the Niagara Falls Works, situated in the State of New York, do not supply New York City, where there is a consumption of electrical energy greater than in any other city in the world. The answer to the question is that it is found that the cost of transmission over the 480 miles from the Niagara Falls Works would result in the electrical energy being delivered in New York at a much higher price than that at which it is possible to produce it in New York itself by means of steam-driven plants, in spite of a price for coal much higher than that in the Transvaal.

Investors, therefore, before embarking their capital upon a scheme for the transmission of electricity a distance of 700 miles, will have to be convinced that the electrical energy so conveyed will be delivered on to the Rand at a much lower price than that at which it can be produced by works favourably situated in the Transvaal.

In this connection it may be again pointed out that the eminent experts who have been consulted by the company have confined themselves entirely to the scientific point of view, and not one of them has pledged himself to the commercial feasibility of delivering the energy from the Falls to the Rand mines with a profit, having regard to the necessity for competing with the lower power costs which the mine-owners have succeeded in attaining with their own plant.

From the investigations which I made during my visits to Johannesburg last year, I am convinced that works situated at Vereeniging, about 35 miles from Johannesburg, where coal can be obtained from the neighbouring pits, and where water, for condensing purposes, can be drawn in abundance from the Vaal River, would generate electric energy at a price much lower than that at which it could be delivered from the Zambesi, and with a much greater assurance of continuity of supply.

This last point is one of great importance, as it is obvious that a line of 700 miles in length through a wild, sparsely peopled country, might be subject to frequent breakdowns. What are the means which the company propose in order to secure continuity? In the first place, the hydraulic works are to be in duplicate. The one works will be erected at Victoria Falls and the other in the Transvaal, the proposition being to operate the Transvaal works by means of a second-class miniature Victoria Falls created by pumping water from a lower reservoir to a higher one, both reservoirs being situated at the Transvaal end of the transmission line.

In the case of the Zambesi Victoria Falls there is, of course, no time at which the supply ceases, but in the case of the projected artificial "Transvaal Falls" the water, when turned on, will only fall for 12 hours, and the engineers who are responsible for this scheme are optimistic enough to suppose that, in the majority of cases, a breakdown of the transmission line will be repaired, and the supply from the Zambesi Victoria Falls restarted within this time. To guard, however, against the contingency of the cessation of supply lasting more than 12 hours, the engineers intend to provide another string to their bow by laying down in the Transvaal works with generating plant of like capacity to the hydraulic plant, but driven by steam. The investor, by this time, will, I think, wonder whether he will ever get an interest upon capital which has to be so considerably augmented by making duplicate and triplicate provisions against breakdowns, and whether the idea of creating duplicate "Victoria Falls" in the Transvaal and their accompanying huge reservoirs above and below is really one in which his capital can be safely invested.

I believe I am right in stating that the company actually propose to locate the upper reservoir 600 ft. above the lower one. It would therefore appear that the projected artificial Transvaal Falls are to be almost double the height of the Zambesi Falls—a proposition which does strike one as somewhat daring and unique in the history of engineering.

It may be taken for granted that the lower reservoir would have to be of the same capacity as the upper one, as it cannot be presumed that any water would be allowed to run to waste in a country where 3s. 6d. per 1,000 gallons is the charge for water made by the Rand Water Board.

The evaporation of open water in the Transvaal goes on at the rate of about 72 in. per annum, and that being so, the whole contents of a shallow reservoir of a depth of 10 ft. would pass away in evaporation in the course of 20 months. A constant supply of make-up water would therefore be required. In order not to have to rely upon the Rand Water Board with its prohibitive price of 3s. 6d. per 1,000 gallons, the supply would doubtless be drawn from a river, and a location found where natural bluffs of the requisite height permitted the construction of the upper reservoir the requisite 600 ft. or so above the lower one.

Those engaged in the making of dams and reservoirs will be able to work out approximately the cost of these huge works, but enough has been said to show that the plan by which the company propose to guard themselves, for 12 hours at a time, against breakdowns of the transmission line from the Zambesi will be a very expensive one, and it will add considerably to the cost of the electric energy delivered to the Rand, especially when the cost of lifting millions of gallons of water to the height of 600 ft. be taken into account.

Then, again, there is the proposed steam plant to act as a further reserve, the capital charges upon which would still further burden the cost to consumers. It is true that the company claim that by the provision of the duplicate water-power in the Transvaal they would be able to do without the expense of keeping the boilers of the steam plant under steam; but what can be thought of a proposition which involves keeping the steam works unstaffed for weeks together, always on the presumption that the breakdowns on the transmission line would not occur more frequently; the only alternative being to incur the expense of keeping up the full staff idly waiting for the transmission line to break down.

To form the proposed new steam reserve station, apparently the company propose to take over one of the mines generating works already in existence, and at the present time supplying a limited group of mines. This station, to be enlarged apparently to a capacity of 20,000 KW, is intended to give an immediate supply to those mines whose owners may otherwise put down their own electric plant. This step seems to me to be unsound. The *raison d'être* of any scheme for supplying the Rand with cheap electric power is the fact that the works in existence are so badly located for their supplies of coal and condensing water as to be operating at unduly high costs. To perpetuate this state of things by enlarging any one of those works is surely a step in the wrong direction.

Take, for instance, the very simple item of water for condensing purposes. It goes without saying that cheap generation could only be attained by the use of large sets of plant working condensing.

The advisers of the British South Africa Co. appear to share this opinion, for I notice that in May last an application was made to the Rand Water Board for a supply to works of which they contemplate the purchase. The price quoted was 3s. 6d. per thousand gallons plus 10 per cent. The quantity required at the start was stated to be 157,680,000 gallons per annum, increasing to a larger quantity as the business increased.

It is true that a reduction to 3s. per thousand gallons is contemplated next year, but be the price 3s. 6d. or 3s., these inland works would start with an extra burden of over £20,000 per annum, increasing by £20,000 per annum for every important addition to the works.

At every turn then, the scheme of the British South Africa Co. involves extra costs of delivering the electrical energy to consumers, and it is not surprising that they are to be called upon to pay a much higher price than was at first contemplated.

From the published account of the recent interview with Mr. H. Wilson Fox, I see that the company expect to be able to supply when their scheme is fully developed at a price which will represent a saving to the mine-owners of 40 per cent. upon the £30 per horse-power per annum which is deemed to be the present cost of power. On the basis of a load factor of 50 per cent., this figure is equal to 1·322d. per unit; whereas I am able to state from what I learnt on my two visits to the Rand last year that it will be necessary to supply at less than 1d. per unit to make it worth while to the mine-owners throughout the Rand to substitute electric power for steam power.

If the Rand mine-owners are willing to pay the additional price to cover the extra costs of the British South Africa Co., well and good, but after all the business of supplying electricity to the Rand will fall into the hands of those who are prepared to offer the consumers the lowest price.

In my opinion, and in the opinion of a number of other engineers, there can be no question that the works which are to be erected at Vereeniging will have no difficulty in selling energy at a price with which the Zambesi scheme cannot possibly compete.

ROBERT HAMMOND.

Westminster, *December 4th*, 1906.

Statue Unveiled.—A statue of the late Principal Viriamu Jones, F.R.S., first principal of the University College of South Wales and Monmouthshire, was unveiled on Saturday by Viscount Tredegar, in the new City Hall, Cardiff. It will be removed to the new college buildings when they are completed.

NOTES.

(*Concluded from page* 910.)

Dinners. — Institution of Electrical Engineers, London.—On Tuesday last the 18th annual dinner was held at the Hotel Cecil, the President, Dr. R. T. Glazebrook, F.R.S., in the chair. Amongst the guests were the Rt. Hon. Lord Justice Buckley, Sir Joseph W. Swan, Sir Norman Lockyer, Sir W. de W. Abney, the Hon. Sir S. McDonnell, Rear-Admiral Sir H. B. Jackson, Sir A. W. Rücker, Sir J. C. Browne, Sir R. Hunter, Sir W. Matthews, Sir J. Kitson, Sir H. T. Wood, Major-Gen. Sir A. E. Turner, Rear-Admiral A. M. Field, Major-Gen. D. D. T. O'Callaghan, Major-Gen. E. R. Festing, Capt. the Hon. F. Hemphill, Alderman J. Frankenburg, Dr. B. A. Whitelegge, Mr. F. W. Chance, Mr. H. Babington Smith, Mr. R. A. Hadfield, Dr. T. E. Thorpe, Mr W. W. Rutherford, Mr. J. Ardron, Mr. H. F. Donaldson, besides many Members of Council and ordinary members and their guests, to the number of about 350.

After the President had proposed the loyal toasts, Mr. H. Babington Smith, Secretary to the Post Office, proposed "The Institution," and remarked on the extraordinary increase in the membership, which had more than doubled in 10 years, and now counted over 6,000 of all classes. The most notable events of the year had been the visit of the foreign Institutions, which had resulted in expressions of warm appreciation of the hospitality of the I.E.E., and in the formation of an International Commission for standardising the nomenclature and rating of electrical machinery; and the signature of the Wireless Telegraph Convention at Berlin. The development of wireless telegraphy had been remarkably rapid; although it was only ten years old, it was already in practical operation, and whereas submarine telegraphy was not accomplished until forty years after the birth of ordinary telegraphy, he thought wireless trans-Atlantic telegraphy would be possible in a shorter period.

The President, in his reply, said that the foreign visit had been a great success, and numerous letters, both public and private, had since been received telling of the pleasure and profit which the visitors had derived from it. Electrical science was cosmopolitan, and the visit had done a great international work.

The Hughes medal of the Royal Society had been presented to their only lady member, Mrs. Ayrton, whom he congratulated on that distinguished honour. He remembered with pleasure teaching her the elements of the calculus.

His acuteness of thought, clearness of exposition, and brilliant experimental work, placed Prof. J. J. Thomson foremost in the ranks of science, and he congratulated him on the award of the Nobel prize. The President finally referred to the tablet unveiled by Lord Kelvin in memory of Michael Faraday, who had laid the foundations of the industry, and said that so long as there was cordial co-operation between theory and practice, progress would be made in future as rapidly as in the past.

Lord Justice Buckley proposed "Science and Industries" in an analytical speech, couched in an abstract philosophical vein, and including a quotation from Matthew Arnold. Sir A. W. Rücker, principal of the University of London, responded, deprecating any artificial separation or distinction between the two, and trusting that they might always be united in education and in the work of the world.

Mr. R. A. Hadfield, president of the Iron and Steel Institute, also replied, referring to the good work done by the National Physical Laboratory, and to the boom in trade. British manufacturers, he said, could face any competition. Metallurgists had done their best to help electrical men, by modifying the properties of iron to suit their needs. Sheffield had now acquired a University, and the manufacturers were glad to avail themselves of the aid of the professors in their work.

Col. R. E. Crompton proposed "Our Guests," and mildly chaffed the L.C.C. on the score of its electrical schemes. He constrasted the arduous labours of the pioneers of electricity supply in London with the light-hearted proposal of the Council to carry out the biggest operation of the kind the world had ever seen.

Mr. F. W. Chance, M.P., replied as a manufacturer who had travelled much, and had often been disheartened when told—abroad—that we were behindhand. He had been cheered to hear, of late, that we were now as far advanced as any other country. The age of handicraft had been superseded by the age of science; we had as good brains as any other nation, and victory would lie with the race that was most intelligently trained.

Capt. the Hon. F. Hemphill (chairman of the L.C.C. Tramways Committee), who shared in the response, said there was a common bond of thought between the Institution and the L.C.C.—the youngest scientific institution, and the youngest municipal body of this country. The L.C.C. was absolutely in accord with the latest thought. Hitherto London had had no adequate supply of electricity at all; it was far behind the great cities of the world, and it was obvious that it could wait no longer for such a supply. As regarded the greatness of the undertaking, the L.C.C. *claimed* to be bigger than other people, because it represented the people of London. Its principle was to use the thoughts of the best engineers that could be obtained and to act upon their advice.

After the speeches, the company adjourned to a reception room for conversation and refreshments, and broke up at a late hour.

During the evening the Imperial Orchestra performed a programme of music, and the arrangements were in every way admirable.

King's College Engineering Society.—The 13th annual dinner of this society took place on Saturday last, at the Trocadero Restaurant. Prof. S. A. F. White occupied the chair, and members of the staff, students and guests to the number of about 150 were present. The chairman having given the loyal toasts, not failing to draw attention to the fact that it was the Queen's birthday, Mr. F. J. Tompson, vice-president, proposed "Our Guests." Sir A. B. W. Kennedy responded, as well as Mr. J. Swinburne, who was in his usual excellent form. He thought that engineers in this country did not take themselves seriously enough, and therefore the world did not. The lay Press did not know much about engineering, and he feared that the only record on Sir Alexander's tombstone would be the number of his *Times* Book Club ticket. The Germans, on the other hand, threw themselves wholly into their work, and lived in the works, while here the owners of manufactories took no pride in their works. He admitted that he was sometimes called "Professor," but that was only by way of insult.

"The College and Staff" was proposed by Mr. N. V. S. Wilton, and Prof. J. M. Thompson responded, remarking that he had been a member of the staff for 35 years, and throughout that period there had never been any misunderstanding between the staff and the students. The chairman proposed "The Engineering Society," and referred to its lapse, under the control of Mr. W. S. Gilbert, to a Shakespearean Society, followed two years later by a return to sanity. By a college education one acquired not only a knowledge of useful subjects, but also a knowledge of the ways of men, an ideal combination. Reading and discussing papers gave self-confidence, and taking part in University sports, &c., gave *esprit de corps*. The president of the society, Mr. C. K. Bird, in a really excellent and well-delivered speech, remarked that the society was 59 years old, and referred to the victories of the King's College football teams in the Inter-Engineering University Rugby football cup competition, and the Inter-Faculty Association competition, last season. Mr. M. Kirke-Smith proposed "The Chairman," and the latter briefly responded.

During the evening members of the staff and students, and the London Viennese Band, performed musical programmes, and the function proved very enjoyable.

Institution of Electrical Engineers (Glasgow Section).—The Right Hon. Lord Kelvin presided at the fifth annual dinner of the Glasgow Local Section, which was held on November 28th. There was a company of about 400 gentlemen, which included the Right Hon. Lord Kingsburgh (Lord Justice Clerk), Colonel Sir Robert Cranston, K.C.V.O., Engineer-Commander Jenkin, R.N., the Bishop of Glasgow and Galloway, Prof. Barr, Prof. Jack, Prof. Magnus Maclean, Dr. Glazebrook, Mr. W. M. Mordey, Mr. Henry A. Mavor, Mr. G. C. Lloyd, Mr. W. W. Lackie, Mr. J. M. M. Munro, and Mr. Robert Robertson.

The toast of "The Institution of Electrical Engineers" was proposed by the Bishop of Glasgow and Galloway. Dr. Glazebrook (President) acknowledged the toast, together with Mr. W. M. Mordey. The former said that it was a distinguished honour to have to respond to that toast in any audience, but it was especially so that evening under the chairmanship of one to whom the Institution owed so much. Dr. Glazebrook referred to the unveiling of the Faraday memorial by Lord Kelvin, and said that on that occasion his Lordship had given them a short address in which he had pointed out how much he owed to Faraday's teaching. Referring to the work of the Institution of Electrical Engineers, Dr. Glazebrook said that numerous papers were read at local sections which did not reach the world so readily and so fully as they could wish. Something more should be done to push forward the publication of papers and the discussions which arose from them in the local sections. Mr. W. M. Mordey, who also responded, described the West of Scotland as the home of electric traction, recalling that in 1837 the first practical demonstration of it was made by Robert Davidson on the Glasgow and Edinburgh Railway before it was opened as a railway. Some day he hoped he would come down from London to attend a meeting of the Section and be drawn in an electrical train. He was quite sure that that would happen within the next 20 years.

Prof. Jack proposed "The Local Section," and said that the reconciliation of the parent body and the local section of the Institution was to be found in one name—Lord Kelvin. Lord Kelvin, in his reply, said that electrical engineers knew that their everyday business was the practical application of science, but they were all scientific men, and would sympathise with every application of their science to extend human thought through the remotest parts of the universe. Dealing with the subject of the toast, his Lordship said that Dr. Glazebrook had spoken of the time when there was no I.E.E. He thought Sir William Siemens was the first to give them the name of engineers. Sir William Siemens was certainly the founder of the Society of Telegraph Engineers, which some time afterwards became the Institution of Electrical Engineers. He remembered Sir William Siemens telling him of work done in the factory at Greenwich, in which they had extraordinary tantrums, if he might use the expression, performed by the dynamos that they had there. The dynamos were simple series wound, and they knew what sort of thing that was if used as a generator to charge a battery, or even to drive a motor at a distance. Sir William and those who worked with him devised the shunt dynamo, and the former told him he had made one which had got over all their troubles. He (Lord Kelvin) begged Sir William to make one for him, and he did so, and during six or eight years at least it was working in a room adjoining the physical laboratory of Glasgow University. It was driven by Clark's gas engine, which did its work well. He believed that really the first thorough practical electric lighting that was done anywhere was done by this Clark's gas engine and Siemens shunt-wound dynamo. He also believed that the first house on this planet in which the whole

lighting was done by electricity was a house in the University of Glasgow, getting the current from that dynamo of which he had spoken. There were 106 electric lights in that house about the end of the year 1881. There had been houses lighted in London by electricity, but not one wholly so at that time.

The toast of "The Corporation" was acknowledged by Bailie P. G. Stewart.

The dinner throughout was a great success.

Institution of Electrical Engineers (Newcastle-on-Tyne Local Section).—The seventh annual dinner of this Section was held at Newcastle on the 28th ult., Mr. H. L. Riseley, the local Chairman, presiding. Dr. R. T. Glazebrook was amongst those present. Mr. I. C. Barling proposed the toast of "The Institution of Electrical Engineers," and Dr. Glazebrook, in replying, spoke of Newcastle as the birthplace of the electric lamp, and said that those who had watched the development of Mr. Parsons's turbine would realise how much electrical science owed to Newcastle. The Chairman also responded. Mr. Gerald Stoney proposed the toast of "Armstrong College and the Learned Societies," to which Mr. F. H. Pruen replied.

Institution and Lecture Notes.—Associated Municipal Electrical Engineers (Greater London).—The above is the title of a society which was successfully inaugurated on Thursday, the 29th ult. Its objects are as follows:—(*a*) The interchange of commercial and technical ideas for the benefit of the municipal electrical undertakings of Greater London. (*b*) To undertake such duties as will tend to reduce the costs of the municipal undertakings. (*c*) To promote the use of standardised apparatus for the utilisation of electrical energy. All the chief engineers of municipal electrical undertakings within a radius of 20 miles of London are eligible as members, and it is interesting to note that the privilege of membership is extended also to one chief electrical assistant from each undertaking. At the initial meeting, 25 chief engineers and eight chief assistants were present, making a total of 33, and about a dozen chief engineers who were unavoidably absent sent letters expressing their intention to join. After the constitution and by-laws of the association had been settled, the election of officers and council took place, and resulted as follows:—

President:—Sidney W. Baynes, St. Pancras.

Vice-Presidents:—C. Newton Russell, Shoreditch; A. Gay, Islington; A. H. Shaw, Ilford.

Hon. Treasurer:—G. G. Bell, Hammersmith.

Hon. Auditors:—A. J. Fuller, Fulham; P. E. Rycroft, Heston.

Members of Council:—

G. H. Cottam, Hampstead.	A. C. Cramb, Croydon.
W. C. Ullmann, East Ham.	A. H. Seabrook, West Ham.
W. C. P. Tapper, Stepney.	Norman Staniland, Hornsey.
J. H. Bowden, Poplar.	F. A. Bond, Battersea.
C. S. Davidson, Barnes.	W. Innes, Poplar.
J. R. J. Bowden, Hackney.	E. Sayer, Hampstead.

Hon. Secretary:—L. L. Robinson, Hackney.

The new society owes its inception to Mr. S. W. Baynes, who was assisted in the preliminary work of organisation by Messrs. Gay, Robinson, Newton Russell, Shaw and Ullmann. It will be seen that the association bids fair to be thoroughly representative of the municipal electrical engineers of Greater London, and the members have so many interests in common that many opportunities for concerted action lie before them.

The Royal Society.—The following paper was to be read yesterday:—Mr. W. Ellis, F.R.S. "A Comparison of Values of the Magnetic Elements deduced from the British Magnetic Survey of 1891 with Recent Observation."

Coventry Engineering Society.—Mr. R. G. Mercer (of the British Westinghouse Co.) gave a lecture before this Society on the 31st ult. on the subject of electric driving. Mr. J. A. Jeckell, manager of the Coventry Corporation electricity works, presided. Mr. Mercer dealt with the advantages of the electric drive, and stated that there was no doubt that the A.C. was far better than the D.C. motor, and he advocated the use of the squirrel cage induction motor; but for individual drive, when the conditions were of a definite character, and when the quality of material operated upon and the tool steel were not liable to change, the A.C. motor furnished an ideal drive. With regard to the lighting of factories, Mr. Mercer said he was glad to think that the idea that gas was superior to electricity as a light was fast disappearing. As to the best source of supply, he said there was no doubt that if they had a town's supply, giving energy at a reasonable rate, it was far better to take that supply than to install their own plant. The question of load factor was very important, and it was self-evident that if they had 20 motors in a factory supplied from the mains, and only one was in use, they would only call for current for that particular motor, whereas with a private plant of one or two big units it was necessary to run those units to operate the one motor.

Leeds University Engineering Society.—Mr. A. H. Barker recently delivered a lecture on "A New Method of Heating Buildings." Water was shown to be the most suitable agent at present known, and the lecturer described an invention known as the "Cable System," which provides automatic circulation at low cost.

Physical Society.—On Friday next the Society will hold an exhibition of electrical, optical and other physical apparatus at the Royal College of Science, from 7 to 10 p.m. Admission will be by ticket only.

Society of Engineers.—On Monday evening last a paper was read on "The Prevention of the Bacterial Contamination of Streams and Oyster Beds," by Mr. W. Pollard Digby and Mr. Henry C. H. Shenton. The authors pointed out the great danger to health arising from contamination by sewage of rivers and fisheries, and explained the use of sodium hypochlorite produced by electrolysis for the sterilisation of the effluents from contact beds or filters, which was shown to be a very simple matter. The cost of sterilising 61,600 gallons of effluent chemically pure—*i.e.*, not liable to secondary decomposition—would amount to 10d., exclusive of capital outlay, which was stated to be small.

Royal Institution.—The lecture arrangements at the Royal Institution, before Easter, include the following:—Mr. W. Duddell, a Christmas course of six experimentally illustrated lectures on "Signalling to a Distance; from Primitive Man to Radiotelegraphy," adapted to a juvenile auditory; Dr. W. N. Shaw, two lectures on "Recent Advances in the Exploration of the Atmosphere"; Major P. A. MacMahon, two lectures on "The Standards of Weights and Measures"; and Prof. J. J. Thomson, six lectures on "Röntgen, Cathode and Positive Rays." The Friday evening meetings will commence on January 18th.

Tramways and Light Railways Association.—At the meeting of this Association, held on 4th inst., the Hon. Arthur Stanley, M.P., who presided, referred to the efforts that had been made to amalgamate the three existing tramway associations, and said that their offer had been definitely refused, and they had had to make up their minds what should be done with their own Association. It was proposed to make their Association representative of every tramway interest in the country, and he proposed raising the subscription from one guinea to two guineas. In addition, it was proposed to admit those who were actively connected with the operations of tramways, such as managers and engineers, on payment of one guinea instead of two.

Junior Institution of Engineers.—On Friday evening, November 30th, through facilities granted by Mr. Jas. R. Chapman, the chief engineer of the Underground Electric Railways Co., of London, a party numbering about 200 paid a visit of inspection to the company's Great Northern, Brompton and Piccadilly Railway, which is to be opened to the public on December 15th. Starting from Piccadilly Circus Station, they were taken by train to the extreme west end of the line at Hammersmith, the working being explained *en route*. On returning, some alighted at Hyde Park Corner Station, to see the special signalling arrangements there, whilst the others proceeded to Covent Garden, where similar apparatus is installed. The whole party, on arriving at Holborn, walked along the tube of the Strand extension works and saw the Greathead shield in operation at the working face. Entering the train again, they went on to Holloway Road Station, and examined with much interest the double spiral continuous electric moving track, which is to travel at 100 ft. per minute and to take passengers up and down simultaneously, and is being fitted in lieu of the lifts. The electrically driven pumping plant at Finsbury Park Station was the last item in a long evening's programme. Here four hydraulic lifts are used, each worked by three rams with a water pressure of 700 lb. per sq. in.

On Monday last week, at Hanley, Mr. C. H. Yeaman delivered the third of his course of lectures on "Electrical Engineering." In a later lecture Mr. Yeaman is to deal with "The Training and Education of Electrical Engineers: their Duties and Prospects in the Profession."

Flexible Suspensions.—The *Lancet*, of December 1st, draws a terrible picture of the dangers of electric lamps suspended by flexible conductors. If a short occurs, and the flexible parts, the lamp may fall on someone's head, and the sharp "pip" may inflict serious injury! There is also the nervous shock due to the bulb "imploding." All this could be avoided, we are told, by using separate cords or wires to suspend the lamps. The cost of this improvement is not mentioned; neither is the fact that, ten to one, the wires referred to would be burnt through by the short.

Electro-Harmonic Society.—The next smoking concert of the season will be held on the 14th inst. at the Holborn Restaurant, commencing at 8 p.m. An excellent programme has been arranged. We note that vocal music will be rendered by Mr. Frederick Ranalow and Mr. A. Heather; instrumental music by Mr. Alfred E. Izard, Mr. Oskar Borsdorf and Mr. T. E. Gatehouse, and miscellaneous items will be provided by Mr. E. Meads, Mr. F. Hastings, Mr. Valentine Hill and Mr. Barclay Gammon. A special feature will be a movement from the celebrated trio of Brahms, for horn, piano and violin.

English Aluminium Enterprise in Switzerland.—It is reported in the Geneva newspapers that a large English company—the English Aluminium Society—proposes to establish an extensive works for the manufacture of aluminium in the valley of the Dranee, near Martigny, in the canton of Vallais. It is believed that if an artificial connection is made between both Dranees before their existing conjunction, it will be possible to obtain water power which will not be less than the equivalent of 8,000 H.P., even in the winter season. The scheme is associated with a proposal for the construction of an electric railway from Orsières to Martigny, whereby a connection would be obtained with the Rhone valley, and, consequently, with the international Simplon railway service. The consent to the building of the railway was given some time ago, although it is only recently that a company has been formed to proceed with the scheme. It will be remembered that the Neuhausen Aluminium Co. is also erecting new works in the Vallais canton, near Chippio.

Appointments Vacant.—Switchboard attendant for Kendal (25s.); mains superintendent for Perth (45s.); three switchboard attendants (£1) for Cleveland and Durham Electric Power, Ltd.; engineer for the North Wales Counties Lunatic Asylum; switchboard attendant for Clacton (30s.).

Dinner Deferred.—The annual dinner of the British Empire Motor Trades Alliance, Ltd., which was fixed for Monday last, has been postponed to a later date, of which due notice will be given.

Leyton Tramways Opening.—On Saturday last, December 1st, the newly electrified tramways of the Urban District Council were opened for traffic by Mr. A. W. Golightly, the chairman of the Council. Officials, councillors and guests met at the Lea Bridge car depôt, and the ceremony of opening and the inspection of the lines were followed by a dinner at the Great Eastern Hotel at Liverpool Street. The dinner practically resolved itself into a love feast between West Ham and Leyton, for both these neighbouring authorities were most fully represented at the festive board, and while revelling in each other's affections, held out little tentative olive branches to the London County Council as an invitation to become a third member in a loving trinity. The L.C.C. had apparently so far leaned towards them as to send a representative dove to the feast of love in the shape of Mr. Rider, who, however, bemoaned the absence of the chief officer, or of his chairman, who could so much better than himself have grasped the olive branch which, as he was only really present in his private capacity, he had with sorrow to leave alone, though he did accept a little leaf in token of amity. It appears, did we hear correctly, that Leyton tramways have a mileage no less than eight, and represent a capital account not very many thousands above £300,000, so that a matter of £12,000 per annum collected in ½d. fares will suffice to pay 4 per cent. interest. Taking the ratio of 50 per cent. as working expenses, we find £24,000 of takings will suffice to pay this interest of 4 per cent., or practically 12 million fares annually, or, say, 32,000 passengers per day. There are, of course, little matters of depreciation and sinking fund also to be considered. However, this is by the way. An endeavour has been made to minimise repairs by thermit-welding all the rail joints, and the tramways are under the control of the manager, not of the committee or of the engineer, a question that was somewhat unduly labboured at the dinner, so much so that a hot bearing somewhere seemed to be squeaking. After all, this is no question of general policy, for the best man to have control is not the engineer or the manager, but the office boy—if the office boy is the best man of the three, and therefore each case should be dealt with on its merits. However, it did come out that the manager was to have control of the whole affair, so that he could do what was best to make the undertaking pay, and he will not require to walk with shut eyes through his sheds so as not to see loafers whom he dare not sack, because such loafers, being voters, and therefore a power in and with the Committee, may not be discharged. Leyton, if it sticks to the profession of the chairman's faith, will therefore escape the evils which are so well known to attach to some municipal undertakings. One of the speakers admitted that their tramways would adversely affect some of the other interests in the area—interests, of course, which, as ratepayers, will be doubly affected for the worse if this tramway undertaking does not pay. How far halfpenny fares will be a success cannot yet be said, but it is to be sincerely hoped that even with a capitalisation of £40,000 per mile of double track, Epping Forest attractions and turough traffic from the L.C.C. *vid* West Ham without change of cars will prevent too heavy a draught out of the ratepayers' pockets, though, like the Scotchman of the story, we may hae oor doots. One thing was clear at the meeting, namely, that both West Ham and Leyton, if faithfully mirrored in their representatives, have no carking cares or wearing doubts as to the wisdom of the electrical policy they have pursued and are pursuing, and this reminds us of a story of Disraeli, who overheard two members discussing the policy of his Cabinet, and interrupted them with the assurance—"Believe me, gentlemen, we are perfectly honest in our endeavours"; to which came the reply, "Sir, we have no doubts upon your honesty; it is your capacity we mistrust." It lies with many municipal people at present to remove this misgiving. The evening was pleasantly diversified by song, and some of the Scotchmen present—however, we let this pass, for the chairman dealt with them pleasantly.

Commercial Development.—Our contemporary, *Electric Light and Power*, commenting on Mr. Borlase Matthews's articles, says:—

"We entirely agree with the writer in his 'key-note,' viz., that the commercial development of an electric supply business must be undertaken by a separate organisation thoroughly systematised, and not, as is too generally the case, left to the resident engineer, whose technical work in connection with the supply is sufficient to occupy all his time and energies. . . . .

"We cannot agree with Mr. Matthews that the wisest plan for organising the commercial department is 'at once to obtain the advice of a consulting engineer.' On the contrary, you do not want the technical man whose occupation is to design the methods of generation and distribution of the current, but a man versed in commercial matters, and with skill in pushing and developing a business."

As regards the last paragraph, our friends might have read to the end of the sentence quoted. They would then have seen that Mr. Matthews was not alluding to the supposed technical man (albeit a sound technical knowledge is indispensable to him), but to one "experienced in modern methods of commercial development, who, with his special knowledge, and by taking into consideration the local conditions, will be able greatly to facilitate the establishment of the department on a sound basis"—in fact, precisely the kind of man that they recommend. They do not believe in canvassers, as adjuncts to the station staff; but they approve of canvassers in the shape of the representatives of wiring and fitting firms, and they fully agree with Mr. Matthews "that the manager of the commercial department will eventually become the most valuable member of the staff of an electric supply undertaking."

The Leblanc Condenser.—An account is given in *l'Eclairage Electrique* for December 1st of a new jet condenser invented by M. Maurice Leblanc, and constructed by the French Westinghouse Co. As shown in the figures, the main feature is the use of a reversed turbine to drive a spreading jet of water into a cone, sweeping out the air and water vapour, compressing them into the convergent cone and allowing them to expand in the divergent cone, where the velocity is checked and the pressure increased so that the whole is discharged against the pressure of the atmosphere. In fig. 1 a simple jet condenser is shown; A is the condensing chamber, B the convergent cone, D the divergent cone, T the turbine pump, and E the inlet for steam, which is used to start the action of the apparatus. If the water is supplied under a slight head, the condenser starts without the use of a steam jet. With this condenser a vacuum of 98 per cent. of the absolute value

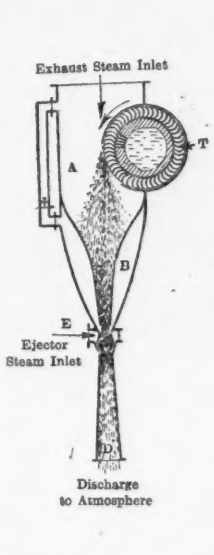


Fig. 1.

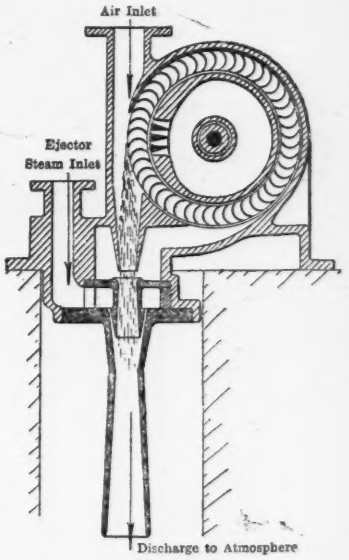


Fig. 2.

The Leblanc Condenser.

can be obtained, using 25 lb. of water per lb. of steam and with an expenditure of power to drive the turbine amounting to 2·5-3 per cent. of the power of the steam engine. There are no valves at all, and the cost of upkeep is trifling. Fig. 2 shows a dry-air pump on this system, which takes less power than reciprocating pumps; it is proposed to use this in conjunction with a centrifugal pump for extracting the water of condensation. This device used with existing surface condensers has allowed of an increased vacuum with less mechanical loss. It has also been employed with a centrifugal pump keyed on the turbine shaft, and enclosed in the same cover; the pump extracts the water, while the Leblanc pump deals with the gaseous products. The exhaust steam enters a conical chamber into which the injection water is squirted through a number of holes round the periphery. With this apparatus, under good conditions, it is said to be possible to reduce the back pressure even below that of water vapour at the temperature of the exhaust steam.

Fall of the Machrihanish Wireless Telegraph Tower.—According to yesterday's *Times*, at the height of a terrific gale on Wednesday the wireless telegraph tower at Machrihanish, Argyllshire, 450 ft. high, and weighing almost 2,000 tons, completely collapsed. The tower, which was erected some time ago by the National Electric Signalling Co, of Washington, U.S.A, for the purpose of wireless communication with America, was a tubular steel structure, containing a stairway leading to the top, and had outside balconies every 100 ft. The stays to the west of the tower were torn from the foundations, and the tower snapped in two places and crashed to the ground. Fortunately, it fell clear of the adjoining buildings, and no one was injured.

Rand Power Supply.—Pressure upon our space prevents our reprinting from yesterday's *Daily Telegraph* financial page an important letter from Sir C. Rivers Wilson, chairman of the Rand Central Electric Works, Ltd., concerning the proposition to supply the Rand with power transmitted from the Victoria Falls. That company has been supplying for 10 years past, as our readers are well aware. Sir Charles shows that measures have been taken by his company for considerably extending its plant so as to meet any demand on the Rand. A reference to the matter was made at the last meeting of the company, a report of which appeared in the Electrical Review for June 1st, 1906.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Engineers.—The Erith Council at its meeting on Monday decided to increase the salary of Mr. F. Thomas Woodward, chief clerk to the electricity undertaking, by £26 per annum.

Mr. H. R. Barnwell has been appointed superintendent of the Barrow-in-Furness Corporation Electricity Works at a salary of £155 per annum.

The staff at Croydon electricity and tramway station are making a presentation to Mr. Sydney Hawkins, who is leaving to take up another position at Stratford.

Mr. C. W. Durnford has been appointed chief engineer to the South Metropolitan Electric Traction and Lighting Co., Ltd.

On Wednesday, November 28th, a supper was held at the Newport (Mon.) Corporation power station, at which Mr. H. Collings Bishop, M.I.E.E, presided. During the evening, Mr. Bishop, on behalf of the Electricity Department, presented Mr. E. J. Nichols, senior engineer-in-charge at the power station, with a handsome kit bag. Mr. Nichols is shortly leaving Newport, to take up an appointment under the York Corporation.

The Loughborough Electricity and Finance Committees have recommended the Town Council to increase the salary of the borough electrical e gineer, Mr. W. H. Allen, by £50 per annum, with a further increase of £50 per annum when the undertaking shows a net profit.

Tramway Officials.—The Oldham Corporation tramway staff have presented a marble timepiece and ornaments to match, to Mr. Woolstencroft, traffic superintendent, who is leaving for Ilford.

The employés of the Blackburn Corporation tramways have presented a gold watch to Mr. J. H. Cowell, the general manager, as a token of esteem.

The Lancaster T.C. has appointed Mr. W. T. Charlton, inspector, as tramway traffic superintendent.

General.—The whole electrical profession will be eager to tender its very warm congratulations to Prof. J. J. Thomson, of Cambridge, who has just been awarded the Nobel prize (£7,500) for his work in connection with physical science. At the Royal Society dinner on November 30th, the chairman, Sir Wm. Huggins, in responding to a toast, asked those present to congratulate Prof. Thomson on the event. Electrical men in this country also are pleased to learn that M. Henri Moissan, of electric furnace celebrity, has been awarded a Nobel prize for his work in chemistry.

According to a Calcutta newspaper, Sergeant-Major F. J. Fisher, Royal Engineers, was last month directed to proceed to Agra for work in connection with the electric lighting of H.E. the Viceroy's Camp.

The Melbourne correspondent of the *Daily Chronicle* says that Mr. Emile Garcke, managing director of the British Electric Traction Co., has arrived there in connection with certain great Australasian electrical schemes. He says: "His position in regard to municipal trading is misunderstood. He only objects to the total prohibition of private electrical enterprise. Private capitalists, he contends, are necessary for pioneer work in many enterprises whose expropriation by the State or municipality would subsequently be justifiable."

The Swansea staff of the National Telephone Co. have presented a silver-mounted salad bowl and dinner cruet to Mr. McCahey, chief electrician, who has been appointed to a position in the superintendent's department at Bristol.

Obituary.—M. Jeantaud.—The death is announced from Paris of M. Ch. Jeantaud, at the age of 63. The deceased was a pioneer of the motor-car in France, and had long devoted considerable attention to the design and construction of electrical automobiles. His first vehicle was built as far back as 1881, and in 1895 he took part with an electrical car in the historical Paris-Bordeaux-Paris road race.

OPPOSITION TO TRAMWAY SCHEMES.

Although the Committees for the Consideration of Private Bills do not commence their sittings until the spring of the year, it is necessary for all who are interested in the promotion of a Bill in Parliament to commence operations some time beforehand. If the Bill is unopposed the difficulties are not formidable; but where there is opposition, much time and expense may be saved to the promoter if he is acquainted with some of the grounds upon which a Bill may be opposed. Indeed, an opponent whose objection is not met may succeed in wrecking a measure after large sums in costs have been incurred.

In order to assist the promoters of electric tramway schemes it is proposed in the present article to consider who may oppose and what grounds of opposition are likely to be fatal. Since the passing of the Scottish Private Bill Act some years ago, the doings of the Committee which sits in Scotland for the hearing of Scotch Bills are reported in "The Scottish Law Reporter." The cases so reported give much valuable information about private Bills in general, and tramway Bills in particular.

First and foremost comes the question—Who may oppose a tramway Bill? A Committee of Parliament would not, for instance, admit anyone who was merely opposed to tramways on principle. In other words, a mere "crank" would not be allowed to occupy the time of the Committee by giving evidence. If we may summarise the results of the authorities which are collected in a well-known legal text-book, "Robertson's Law of Tramways and Light Railways," (1903) p. 12 *et seq.*, the following rules appear to apply:—A railway company cannot, in general, oppose a tramway on the ground of competition; but where steam or electricity is used as the motive power a *locus* may be conceded. The referees (who have to decide the question) will consider the circumstances of each particular case; and their tendency is to regard a tramway of the modern type as capable of offering serious competition to a railway. At this point it should be observed that the referees only have power to decide whether a right to oppose (or, to use the ordinary phrase, a *locus standi*) shall be conceded; the question whether that opposition is sufficient to wreck the Bill rests with the Committee.

A *locus standi* will also be conceded to a railway company which asserts that telegraphs, signalling apparatus, &c., will be affected by induction. As a general rule this class of opposition is met by the insertion of a special clause in the private Bill, or by a section in the Tramways Act, 1870, which is of universal application.

It is now proposed to consider some of the Scotch cases of recent date in which the question of *locus standi* has been considered.

In the Kidderminster and Stourport Electric Tramway Bill, 1896, the petitioners were a gas company, who alleged that the Bill would authorise the promoters to interfere with the access to, and the maintenance of, their mains and pipes. They alleged, amongst other things, that it would be impossible to work the tramway without liability to explosions, which recent experience had shown might take place through sparking. The promoters contended that the petitioners were sufficiently protected by the model clauses in the Bill; but in spite of this, they were held entitled to appear before the Committee and to call evidence in opposition to the Bill.

In a much more recent case (the Wemyss Tramways Provisional Order (42 S.L.R. 886)), a provisional order was promoted for the purpose of laying down a tramway. It was opposed by the North British Railway Co. and the Dysart Water Commissioners, to whose *locus standi* in the matter objection was taken on the part of the promoters. The Commissioners opposed on the ground that they were the owners of some 700 yards of piping underneath the roads proposed to be traversed by the tramway. Further, it was argued on their behalf that they were bound to supply water within a much wider district than they were doing at present, and they were entitled to be protected not only in their compulsory district, but also in their permissive area of supply. In these circumstances it was contended that the model clause and the Board of Trade regulations with regard to electrolysis were not sufficient protection.

In the event the Commissioners granted a clause to the effect that "The provisions of Secs. 30 and 32 of the Tramways Act, 1870, as altered by the order, shall apply to all the waterworks, mains, pipes, fittings, apparatus and property belonging to the Commissioners (including consumers' premises), whether within or beyond the limits of compulsory supply." With reference to the Tramways Act, 1870, it may be observed, in passing, that this measure contains a number of provisions which are intended to protect gas companies, &c., from any injury which may be occasioned in the working of the tramway, but the protection so afforded is not always considered sufficient.

In the Paisley District Tramways Provisional Order ((1905) 42 S.L.R. 888), the position of the National Telephone Co. was considered in relation to alleged interference with their system by an electric tramway. The evidence for the National Telephone Co. was to the effect that the construction of the tramways would interfere with the telephone apparatus, and would occasion great expense in the way of heightening the poles and altering the wires. They submitted, and asked for the insertion of, special clauses dealing with these matters. For the promoters it was argued that the telephone company were not entitled to be put in a position equivalent to that of the Postmaster-General. Ample provision for their protection was made by the Tramways Act, 1870. Further, the lines would be laid down under the supervision of the Board of Trade, who would see that the National Telephone Co. were protected. In the event, the Commissioners refused to insert the clauses asked for.

The Edinburgh Suburban Electric Tramways Bill (1905, 42 S.L.R. 894) involved the discussion of a number of novel and interesting questions. The provisional order was promoted by a company to obtain power to construct and work an electric tramway line, commencing at the boundary of the city of Edinburgh, to Dalkeith and other places. The Bill was opposed by the Cyclists' Touring Club, on the grounds, *inter alia*, that the placing of a tramway along the road in question, close to the footpath, would be a source of danger to cyclists. The promoters contended that the club were not entitled to be heard, their rights and interests, as users of the highway, being safeguarded by the Local Authority, who were represented before the Committee. Reference was made to the North and South Shields Electric Railway Bill, 1902 (2 S. and A. 137) where the Cyclists' Touring Club opposed a Bill on the ground that they objected to the proposed rates to be charged for cycles on the promoters' railway. They were refused a *locus*. In spite of that authority, the committee in the case under review allowed the Cyclists' Touring Club to be represented and heard before them, but they did not apparently attach much weight to the objection, as no special clause was inserted for the protection of cyclists.

With regard to the carriage of goods by tramway companies, it seems that the mere fact that a railway company object will not induce Parliament to refuse to grant such powers. In the Edinburgh Suburban Electric Tramway Bill, to which allusion has already been made, the tramway company asked for powers to carry (in addition to passengers' luggage) "goods, minerals, articles and things." The North British Railway Co., who opposed, said they did not oppose the carriage of parcels up to 56 lb. in weight, but beyond that it would be a very bad precedent to establish that tramways might carry goods. No such power had ever been granted except in one case (the Wemyss Tramway Order, 1905) where the circumstances were peculiar. It was pointed out by the promoters, however, that in all cases where the weight of parcels to be carried had been limited, that was matter of agreement between the parties, and that in England such a power was always conferred. In the event, the Committee granted full powers.

Cases have arisen from time to time upon the question whether and how far an electric tramway company should be held responsible for injuries caused by their current to the instruments and apparatus of railway companies. In the Edinburgh Suburban Electric Tramways (1905, 42 S.L.R., 894), the North British Railway Co. sought special protection against (*inter alia*) damages to their signals and other electrical apparatus by electric induction. On behalf of the promoters it was urged that Clause 54 of the order was a special provision for the protection of the railway company from risk. That clause has been founded upon the clause recommended by Lord Cross's Committee, the theory of which was that having complied therewith, the promoters were deemed to have taken all reasonable precautions against injurious interference. On behalf of the railway company it was argued that it was only fair that if the tramway company did harm to the railway company, it should pay for it. The clause proposed threw responsibility on the tramway company, not only when it had not taken all reasonable precautions under the direction of the Board of Trade, but also when there was induction, in spite of those precautions. In the event, the Committee declined to grant the clause.

CITY NOTES.

Aron Electricity Meter, Ltd.

Mr. H. Hirst presided at Winchester House, E.C., on Wednesday, over the ninth ordinary general meeting of the above company.

In moving the adoption of the report (see Electrical Review, November 30th, page 879), the Chairman said that for the first time during the five years he had been chairman he was able to rise at the annual meeting with some sense of gratification. The report presented fully bore out their prognostications. The company had passed through critical times, and, thanks to the efforts of Prof. Aron and his staff, the unanimity of the board and the loyal support and patience of the shareholders, they had been able to successfully wend their way through a veritable jungle of adversity, and had emerged all the better and all the stronger for it. Thanks to the success which their re-designed—he might almost say re-invented—instruments were enjoying, they had been able to obtain a gross profit on trading of £30,329. This figure was all the more encouraging when they realised that it had become necessary to change many types of instrument that they manufactured to suit the changing and varying conditions that the progress of the electrical industry demanded. Whilst the former profits of the company both before and immediately after its formation were secured by the sale of instruments, the average price of which was from £5 to £6 each, the average price of the instruments they were selling at present was only from £2 to £3. This told how much larger the business had grown, and how much more complete its organisation and management were in order to deal with the greater quantity of manufacturing and sales. The general expenses and amount set aside for depreciation reduced the gross profit to a net profit of £17,212 14s. 3d., but from the swing in which they were at present, it was not unreasonable to expect in the coming year an increase in the gross profit without a proportionate increase of the expenses. Since the formation of the company they had spent on capital account a sum exceeding £50,000, and had depreciated during that time the sum of over £30,000, not reckoning an amount of £10,000 to £12,000, which had been spent on maintenance of old patents, and the taking out of new ones. All this expenditure had been on account of new buildings, land that had appreciated in value, and most modern tools and machinery, and it was worth every penny that they have spent. Proceeding to deal with the balance sheet, the chairman said the question had been asked why they did not pay more dividend. He assured them that the directors were fully alive to the fact that it was desirable to pay back as soon as possible the dividends owing for past years, and they were very anxious for general and personal reasons to see the ordinary shares participate at an early date in the profits of the company. Still they had to realise that this year, they had to start to pay back out of capital, the actual debenture issue at the rate of about £5,000 per annum. They were a company whose principal business was at present done on the Continent, yet they were an English company with all its advantages and its disadvantages. This ensured a certain continuity of the same interests of a considerable section of the shareholders. It secured to the company the most useful advice of matured financiers, it helped the company in the obtaining of remunerative business, and frequently these institutes could exercise a salutary influence on competing firms by directing their energies in special directions, thus enabling them to produce cheaper. The English manufacturing concern, without any assistance, could so easily specialise, and had to be prepared to meet all and every kind of orders. It was not infrequent that in tenders for electrical machinery in this country some 50 to 60 competing firms bid against each other, whilst on the Continent in a similar case there might be at the outside 10 or 12. Thus the cost of time for working out and following up these fruitless tenders, on the one hand, was saved, and the opportunity of making more apparatus of the same kind, on the other hand, enabled the foreign manufacturer to supply the public as cheaply or cheaper than the English company could, and with more profit to himself. After full consideration they had decided to defer further payment of dividend until they had had six months' experience of the new year, but he was very sanguine, that in spite of the cautious policy they had adopted, they would at a much earlier period than seemed probable a year ago, be able to satisfy the shareholders and yet establish that security at which they were aiming.

Sir James Pender, Bart., seconded the motion, and after a short discussion it was adopted.

Castner-Kellner Alkali Co., Ltd.—Mr. Gerald W. Balfour presided at the meeting held at Cannon Street Hotel on 29th ult. He dwelt upon the desirability of their strengthening, as far as possible, their relations and their financial position, keeping an open eye for all possible developments and improvements in the business, and to keep the whole plant in apple-pie order and up-to-date. The works at Newcastle were now in successful operation. Following out the policy which dictated the establishment of works at Newcastle, they had also, within the last few weeks, entered into a contract for a further extension of the gas engine plant at Weston Point, and when all these changes were completed they might say, in respect of their plant, that they were absolutely abreast of the times, if not ahead of anybody else. A resolution was passed declaring a dividend at the rate of 7 per cent. per annum for the six months.

Isle of Thanet Electric Tramways and Lighting Co., Ltd.—The report for the year ended September 30th last shows a profit of £12,949. The traffic receipts show an increase of £172 and sale of electricity an increase of £490. The directors propose to devote £300 from the revenue for writing off the cost of reconstructing bogie cars, and to place £2,000 to a reserve and renewals account, leaving a balance of £2,251; one quarter's dividend on the preference shares absorbs £1,875, and it is proposed to carry forward £376. During the year the system has been almost entirely free from accidents. The arrangement in force since the accidents which occurred last year of changing the drivers at the approach of the steep gradients and allowing only the most experienced motormen to operate the cars on these sections, has no doubt greatly conduced to this satisfactory result. As a further security the company are, on the recommendation of the Board of Trade, now engaged in making improvements in the line on Madeira Hill, Ramsgate, where one of the most serious accidents took place in 1905. The effect of previous accidents is still felt in the high premium which has had to be paid to protect the company against third party risks. Owing to the excessive load on the generating plant in August, when the heaviest traction and lighting loads of the year overlap for a few hours each day, the directors have not been able to develop the lighting business as effectually as they might have done if they had a larger reserve of plant. They have, therefore, made arrangements to install a gas producer plant of 100 kw. capacity, which is considered the most economical way of supplementing the capacity of the existing plant.

The American General Electric Co.—At a meeting of the General Electric Co., held at Schenectady, U.S.A., last month the capital stock of the company was increased from $60,000,000 to $80,000,000 to enable the company to meet the enormous increase in business. The company's various plants are to be enlarged. There are 16,000 employés at Schenectady.

R. Hornsby & Sons, Ltd.—Mr. H. Sampson Gee, presiding at the annual meeting held on 3rd inst. in London, said that it cost them £95,450 to acquire the business of Messrs. J. E. H. Andrews, of Stockport, which had been paid in 6 per cent. shares, and 5 per cent. debentures. The business was earning over 6 per cent. at the time of purchase, and during the first year's working of the amalgamation it had materially added to the company's profits, which had been £23,397, as against £15,476 in the previous year.

Stock Exchange Notices.—The Committee has ordered the undermentioned securities to be quoted in the Official List:—

Kuala Lumpur Rubber Co., Ltd.—175,350 shares of £1 each, fully paid, Nos. 1 to 173,350 and 178,001 to 180,000.

Madras Electric Supply Corporation, Ltd.—Provisional certificates (partly paid) for £250,000 five per cent. construction debenture stock.

National Electric Construction Co., Ltd.—170,000 shares of £1 each, fully paid, Nos. 1 to 170,000.

The Electromobile Co., Ltd.—According to a report in the *Morning Post*, Mr. Ernest Schenk, who presided at this company's meeting recently, in commenting upon the trading profit of £6,157 made during the year, stated that the unqualified success of the electromobile in the Automobile Club's Town Carriage Competition had already increased the sales of carriages. He questioned the statement that the electric carriage was only a luxury of the rich, and challenged either petrol or steam on the grounds of economy of running alone. He expressed a hope that the new garage which the company had begun to build in Mayfair upon a site of over half-an-acre, and at a cost of about £25,000, would be opened in time for the next London season.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight.		No. of wks.	Total to date.		Route miles open.	
		£	£*		£	£*		*
Aberdeen	Nov. 28	2,341	+ 52	26	39,561	+ 2,055	14·4	..
†Ayr	,, 24	169	— 5	28	9,978	+ 162	8	..
Bath	,, 28	1,345	+ 173	48	39,695	+ 6,864	13	..
Belfast	,, 30	6,708	+2,018	48	159,125	+49,798	40	+ 6½
Birkenhead	Dec. 2	1,451	+ 86	35	37,681	+ 1,004	13·5	..
Blackburn	Nov. 28	1,260	+ 156	35½	37,506	+ 2,456	13·6	..
Blackpool Corp.	,, 29	651	+ 123	33	47,680	+ 3,614	11·87	..
,, —Fleetw'd	Dec. 1	396	+ 86	23	23,260	+ 3,753	8·25	..
† ,, —Lytham	Sep. 2	825	+ 155	39	12,897	+ 1,353	7½	..
Bolton	Dec. 3	4,0.3	+ 454	35	75,634	+ 6,217	26	+ 1
Bournemouth	Nov. 28	2,5 8	+ 177	34½	60,922	+10,836	20·5	+ 1¾
Bradford	Dec. 1	8,488	+ 502	35	161,7 3	+ 6,964	53	+ ·7
Brighton	,, 2	1,475	+ 12	35	36,673	..	9·5	..
Bristol	Nov. 30	9,421	+ 719	..	...	..	28·5	..
Brit. Elec. Trac. Co.								
Airdrie	,, 23	433	+ 24	47	10,465	+ 817	3·65	..
Barnsley	,, 23	297	— 6	,,	7,643	+ 23	..	..
Barrow	,, 23	4 0	+ 52	,,	12,271	+ 934	5·37	..
Cavehill	,, 23	96	+ 38	,,	4,204	+ 1,887	..	..
Devonport	,, 23	825	+ 80	,,	21,692	+ 112	8·85	..
Gateshead	,, 23	1,918	+ 91	,,	45,795	+ 2,507	11·25	..
Gravesend	,, 23	418	+ 36	,,	11,485	+ 603	6·5	..
Greenock	,, 23	964	— 201	,,	31,233	+ 915	7·25	..
Hartlepool	,, 23	509	+ 34	,,	14,309	+ 1,671	6·72	..
Kidderminster	,, 23	174	+ 2	,,	5,659	— 43	..	..
Leamington	,, 23	292	+ 41	,,	8,251	+ 2,735	3	..
Merthyr	,, 23	384	+ 44	,,	9,351	+ 444	2·9	..
†Metropolitan	,, 23	6,156	+1,268	,,	161,622	+26,520	22	..
Middleton	,, 23	572	+ 12	,,	16,606	+ 694	8·5	..
Mid. Joint Com'tee	,, 9	18,414	—1,392	,,	454,325	+14,823	..	..
Oldham — Ashton	,, 23	1,050	+ 11	,,	26,985	+ 768	9·13	..
Peterborough	,, 23	194	+ 7	,,	6,1 6	— 229	5·31	..
Potteries	,, 23	3,719	+ 193	,,	84,521	+ 4,304	29	..
Rotherham	,, 23	8	+ 5	,,	10,810	+ 1,609	2·75	..
Southport	,, 23	439	+ 11	,,	15,250	+ 512	8·17	..
S Metropolitan	,, 23	1,2 6	..	41	14,584	..	..	..
Swansea	,, 23	1,622	+ 200	47	39,6 2	+ 5,730	5·5	..
Tynemouth	,, 23	201	— 24	,,	12,211	+ 23	3·75	..
Weston-s-Mare	,, 21	57	+ 8	,,	7,3 5	+ 632	3	..
†Worcester	,, 23	461	+ 16	,,	13,468	— 768	5·75	..
Wrexham	,, 23	179	+ 14	,,	4,916	+ 187	..	..
Yorks. Wool. Dist.	,, 24	1,744	+ 353	,,	42,738	+11,778	17	..
Miscellaneous	,, 23	173	— 6	,,	5,012	— 251	..	..
Burnley	Dec. 1	2,289	+ 197	47	..	..	7·5	..
Burton-on-Trent	,, 2	510	+ 14	35	10,688	— 416	10	+ 1·5
Bury	Nov. 25	1,795	..	34	34,158	..	10·5	..
†Cardiff	,, 17	1 822	+ 93	33	70,414	+ 969	15·87	..
Carlisle	Dec. 1	315	+ 14	48	8,940	+ 137	..	..
Chatham and Dist.	Nov. 29	1,248	+ 207	48	33,236	+ 1,762	12·8	+ 3 5
Cork	,, 29	824	+ 65	43	23,103	— 43	9·89	..
Croydon	,, 30	2,5 8	+ 587	26	49,709	+ 4,608	12	+ 1½
Darlington	Dec. 1	469	+ 15	35	7,543	+ 282	4·27	..
Darwen	Nov. 30	486	+ 36	35	9,035	+ 457	4·36	..
Dover	,, 24	373	+ 24	34	9,286	+ 1,210	4·75	..
Dublin	,, 30	9,362	+ 509	22	117,452	+ 6,280	18·75	+ ·25
Dundee	,, 28	2,664	+ 509	26	31,566	+ 5,750	13	+ ·5
East Ham	Dec. 1	1,567	+ 102	35	32,358	+ 3,148	8	+ ¼
Exeter	Nov. 30	616	+ 131	35	10,695	+ 328	4·75	+ ·5
Glasgow	Dec. 1	33,118	+3,675	29	448,746	+41,940	84·5	+ 8½
Hastings	Nov. 30	1,142	..	..	..	..	..	..
†Huddersfield	,, 24	1,475	+ 187	34	52,616	+ 4,979	28	..
Hull	Dec. 1	4,295	+ 260	35	81,668	+ 3,378	13	..
Ilford	,, 1	814	+ 69	36	17,841	+ 413	6·37	..
Ilkeston	Nov. 28	257	+ 37	35	4,815	+ 550	3·5	..
Ipswich	Dec. 1	647	+ 40	35	15,880	+ 133	10·5	..
Isle of Thanet	,, 1	447	— 7	48	31,529	+ 942	11	..
Kilmarnock	,, 1	291	+ 23	29	4,675	+ 87	4·25	..
†Kirkcaldy	Nov. 14	252	+ 57	..	..	..	7·5	..
Lan'kshire Trm. Co.	,, 29	1 720	+ 144	48	42,531	+ 6,527	12·56	+ ½
Lancashire United	,, 28	2,152	+ 254	48	47,920	+ 6,650	87	+ 9
Leeds	,, 24	11 665	+1,175	24	216,654	+14,206	96	+ 6·5
Leicester	Dec. 1	4,146	+ 333	48	..	..	..	..
Leith	Nov. 24	945	+ 172	28	14,808	+ 5,665	6	+ 1
Liverpool	,, 24	21,014	+1,288	47	507,846	+12,599	104	+ 1
†L.C.C.	,, 17	50,0 8	..	33	870,008	..	108½	+57½
London United	,, 30	10,423	+1,753	48	288,007	+25,785	..	..
Lowestoft	Dec. 1	305	+ 42	9	1,642	+ 255	3·5	..
Manchester	,, 1	26 869	+2,685	35	489,6.0	+37,494	146	+21
Newcastle	,, 1	7.956	+1,048	35	143.5.5	+10,589	25·5	..
Newport	Nov. 24	1,167	+ 133	34	22.024	+ 1,691	14·5	+ 1·5
Northampton	,, 30	714	+ 47	35	15,847	+ 526	5·5	..
Oldham	Dec. 2	3,467	+ 342	36	65,945	+ 6,592	23·75	..
Pontypridd	,, 1	307	+ 39	35	5,919	+ 274	3·25	..
Portsmouth	,, 1	2.941	+ 251	35	73,736	+ 947	14·5	..
Preston	Nov. 28	1,332	+ 236	..	..	..	10	..
Reading	,, 29	1.163	+ 124	35	22,708	+ 473	7·5	..
Rochdale	Dec. 1	1,765	+ 270	34	..	..	20·6	..
Rotherham	Nov. 29	978	+ 142	35	17,750	+ 1,713	10	+ ·33
Salford	,, 26	8,777	+ 609	34	156,463	+ 6,2 3	38·9	..
Sheffield	Dec. 2	10,673	+1,179	36	191,746	+14,110	55·75	+ 1½
Southampton	Nov. 28	1,727	+ 114	34	34,775	+ 616	..	..
†Southend-on-Sea	,, 28	257	+ 34	35	15,262	+ 958	6	..
Sunderland	Dec. 2	2,540	+ 198	35	50,271	+ 3,064	10·87	..
†Swindon	Nov. 28	153	— 8	33	6,300	..	4·4	..
Tyneside	,, 28	810	+ 176	48	21,846	+ 2,094	8·87	..
Walthamstow	Dec. 1	849	..	35	21,5 7	..	9	..
West Ham	Nov. 29	4,148	+ 667	45	80,106	+17,069	14·7	+ 1·4
Wolverhampton	,, 28	1,585	+ 162	34	30,046	+ 1,698	12·5	..
Yorks. W. Riding	Dec. 2	2,119	+ 780	48	41,267	..	..	..
Baker St.-Waterloo	,, 1	4,075	..	22	31,910	..	3·75	..
Cen. London Rly.	,, 1	18,491	— 654	22	131,981	— 6,142	6	..
City & S. Lon. Rly.	,, 2	5,520	— 349	22	58,611	+ 1,796	6·25	..
Dublin-Lucan Rly.	Nov. 30	192	+ 16	22	2,797	— 1	7	..
G.N. and City Rly.	Dec. 1	3,803	+ 191	22	57,362	+ 2,344	3·5	..
L'pool Overh'd Rly.	,, 2	2,788	+ 86	22	32,742	— 371	6·8	..
Mersey Railway	,, 1	3.659	+ 282	22	37,368	+ 2,809	4·5	..
Metropolitan Rly.	,, 2	31,146	..	22	327,426	..	70·5	..
Met. District Rly.	,, 2	16,717	+ 658	22	169,149	+13,026	24	..
Anglo-Argentine	,, 2	34,124	+3,919	48	730,695	+85,527	48	..
§Auckland	Nov. 9	9,728	+ 639	42½	109,562	+ 7,367	19·24	+ ·6
§Brisbane	Oct.	11,721	+1,371	..	..	..	..	..
§Brit. Columbia Rly.	,,	25,542	+3,541	17	93,472	+12,248	..	..
†Bu'n's A'r's E.T.Co.	Nov. 3	2,017	+ 338	44	60,712	+ 9,035	24	..
Bu'n's A'r's-Bigr'no	,, 25	7,551	+ 650	47	171,422	+ 8,990	..	..
Calcutta	Dec. 1	6,684	+ 714	..	..	..	..	..
§Cape Electric T. Ld.	Oct.	14,475	..	..	..	..	..	..
§Geneva	,,	7.971	+ 299	..	..	..	..	..
§Kalgoorlie, W.A.	,,	3,985	..	48	42,933	..	20·5	..
Madras	Nov. 30	931	+ 124	47	21,042	+ 2,544	10·5	+1½
§Lisbon	Oct.	26,876	..	..	..	..	..	..
§Mexico	Sep.	74,400	..	..	..	..	..	..
Perth (W.A.)	Nov. 30	2,826	+ 12	48	69.494	+ 8,608	24·25	+5

* Compared with the corresponding period of 1905. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Evening.

December has a poor reputation in the Stock Exchange. Prices are too generally inclined to fall away with the end of the year, when money becomes tighter, and the spending powers of the community are directed to the Christmas markets rather than those of the Stock Exchange. So far, however, this influence has not troubled Capel Court. There are whispers of a possible reduction in the Bank Rate, and these have the effect of steadying investment securities all round. The Telegraph section has a few improvements in its more gilt-edged issues, although it is in this department that the drop of 2 points in Eastern Telegraph Ordinary stock provides one of the principal declines on the week.

Home Rails are enjoying one of their desultory spurts, for which the approach of dividend time may be responsible. The rise up to the present has not extended to the electrical stocks, except Waterloo and City, which is 1 better, but Metropolitan Consolidated at 64½ has strengthened, and Districts are 20½, after falling to the round score. Underground Profit Notes at 90 are *ex* the dividend just paid.

Electricity supply shares can make no definite upward movement until the power question for London comes within reach of settlement. Westminster Ordinary are ¼ down, and the Preference ⅛; County Preference recovered part of their last week's loss, and are 11, though the Ordinary fell ⅛ to 8¼, while Charing Cross Preference at 4½ have fallen a fraction. Kensington and St. James' are both lower. Urbans improved to 3½.

Where business is active in this department is in securities of the various electric lighting and power companies abroad, most of them owning Canadian parentage. For instance, there are the 5 per cent. Gold Bonds of the Mexican Electric Light Company, which stand at 80, and bonds bearing similar interest in the Mexican Light and Power Company, the price of these being 86. The latter concern's capital stock is quoted at 59½. Canadian General Electric $100 common shares are 144½. Then there are the lighting and power undertakings of San Paulo and Rio de Janeiro; a lot of business is passing in these, and dealings between the London Stock Exchange and the Exchanges of Montreal and Toronto are regular daily features.

Inquiring in the market the other day for a reason why Eastern Telegraph Ordinary stock should have fallen two more points, to 136½, the only explanation available seemed to be that the price was depressed by reason of the prevailing stiffness of money, and not in any way owing to intrinsic causes connected with the company itself. The dividend is not regarded as being in any danger of reduction, and the amounts put to reserve every half-year are being well maintained. At the present price the stock returns rather over 5 per cent. on the money. Competition has grown, and is growing, keener, as everyone knows, and this may have something to do with the disinclination of the general investor to put money into the stock, and so support the price.

Anglo-Americans are better, and Direct Spanish prior issues have improved. The 4s. dividend on West African Telegraphs is deducted, but the price remains unaltered at 10¼, the West India and Panama First Preference, *ex* 8s. in all, are marked down ⅜ at 7⅞, and the Ordinary eased off to 1 1/16. At ⅝ West Coast of America have slightly eased. Telephone issues show 1/16 decline in Monte Video as their only change.

A fresh improvement of 2s. 6d. in British Electric Traction Preference left the price at 8½. The First Debenture has gained, and the Second Debenture has lost, 1 per cent. Belgranos improved with other Argentine properties, but Anglo-Argentines did not move. Potteries at 6½ are ¼ down. The hint was ventured here a week ago that Willans & Robinson Preference had gone about as low as they were likely to, and the price is up a further 5s. at 55s. now. Even the Ordinary put on 5s. at 1¼. Manufacturing shares on the whole are dullish, British Aluminium Ordinary furnishing a bright exception. The price is ⅜ better at 5 1/16. But Westinghouse Debenture has fallen 2 to 75, Callender's and Henley's ¼ each, and Castner-Kellner 1/16. General Electric Debenture rose 3 to 95½, and Henley's Preference put on a small fraction.

Diesel Engine Co., Ltd.—At an extraordinary general meeting, held on 29th ult. at Cannon Street Hotel, a resolution for reducing the capital from £500,000 to £137,500 was passed. The nominal amount of the preference shares is to be reduced to 10s. each, and that of the ordinary to 5s. each.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last four years.				Closing Quotations Nov. 27th.	Closing Quotations Dec. 4th.	Business done week ended Dec. 4th, 1906.		Rise + or Fall —
			1903.	1903.	1904.	1905.			Highest	Lowest	
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	3⅛ — 3⅜	3⅛ — 3⅜	..	..	..
155,600	Do. do. 5 % Debs., Nos. 1 to 1,200 Red.	100	Nil	Nil	Nil	5 %	84 — 93	88 — 93	..	..	..
702,600	Anglo-American Telegraph	Stock	60/6	61s.	2¾%	3½%	†6 — 68	66¼ — 68⅞	..	..	..
3,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5⅛%	6 %	109 —110	109⅝ —110⅜	110⅜	109⅞	+ ⅛
3,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	½%	26⅜ — 26⅝	27⅜ — 27⅝	27½	26½	+ ⅛
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	101½—102½	102 —104	..	..	+ ⅛
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	8 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..
1,982,866	Commercial Cable Stlng. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	97 — 99	97 — 99	97½	97	..
16,000	Cuba Telegraph	10	6¾%	10 %	5 %	5 %	8½ — 9	8½ — 9	..	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 — 18	17 — 18	..	..	..
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	8⅜ — 8⅝	8⅜ — 8⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8⅞ — 9⅛	9 — 9¼	..	..	+ ⅛
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	99½—102½	99 —101	..	..	—1
60,710	Direct United States Cable	20	8½%	8 %	8½%	4½%	15⅜ — 16⅛	15⅜ — 16⅛	16⅛	15 11/16	..
65,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200,B.	100	4½%	4½%	4½%	4½%	100½—102½	101 —103	..	..	+ ⅛
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	137 —140	135 —138	139½	134	—2
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%	90 — 92	90 — 92	91	90	..
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	105½—107½xd	105¼—107½	..	..	..
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	13⅜ — 13⅝	13⅜ — 13⅞	13 11/16	13 7/8	..
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	105½—107½	105¼—107⅛	107½	..	..
800,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..
200,000	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..
180,887	Globe Telegraph and Trust	10	£3	5½%	5½%	5½%	10½ — 10⅝	10½ — 10⅝	10 11/16	10⅝	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14½ — 14⅝	14½ — 14⅝	14⅝	14½	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	24%	36 — 38	36 — 38	30	36½	..
37,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100½—102½	100½—102½	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	12 %	13 %	58½ — 60½	58½ — 60½	58½	..	..
251,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..
72,680	Monte Video Telephone Co., Ltd. Ord.	1	8 %	8 %	4 %	5 %	1 1/16 — 1 1/8	1 — 1⅛	..	..	— 1/16
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	⅞ — 1	⅞ — 1	..	..	..
1,988,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	107½—109½	107½ - 109½	109½	107⅝	..
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	6 %	107 —109	107 — 109	108	107⅛	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	11 — 13	11 — 13	12⅛	11⅞	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10½ — 12½	10½ — 12½	..	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	5 3/16	5 1/16	— 1/16
2,000,000	Do. do. 8½ % Deb. Stock Red. ..	Stock	8½%	8½%	8½%	8½%	97½ — 99½	97 — 99	..	..	—
1,589,598	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100½—102½	101 —104	..	..	+1
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6¾%	6¾%	7½%	1½ — 1⅝	1½ — 1⅝	..	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1⅜ — 1½	1⅜ — 1½	..	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	97 — 99	97 — 99	..	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
11,839	Reuter's	8	5 %	5 %	5 %	5 %	7¼ — 7⅜	7¼ — 7⅜	..	..	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	..	4½%	101 —104	101 —104	..	..	..
8,201	Submarine Cables Trust	Certs.	6 %	6 %	6 %	6 %	126 —129	126 —129	..	..	..
70,000	United River Plate Telephone	5	7 %	8 %	8 %	8 %	6⅞ — 7⅜	6⅞ — 7⅜	..	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5¼ — 5⅝	5¼ — 5⅝	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	110 —113	110 —113	..	..	..
15,609	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	10 — 10⅜	10 — 10⅜ xd	..	..	..
80,008	W. Coast of America, 1 to 80,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	Nil	1/16 — 1/8	1/16 — 1/8	13/16	11/16	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	100½—105½	100½—103½	..	..	..
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980 ..	10	7 %	7 %	7 %	7 %	14 — 14½xd	14 — 14½	1½	..	..
568,280	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	109 —105	101 —104	102½	101	—1
88,821	West India and Panama Telegraph.	10	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	14/9	13/16	—1/16
84,568	Do. do. 6 % Cum. 1st Pref.	10	7 %*	7 %*	6 %	5 %	8⅛ — 8⅜	7⅞ — 8	7⅞	6⅛	— ⅛
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	5⅝ — 6⅞	5⅝ — 6⅞	..	..	..
80,000	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	101—104	101 —104	..	..	..

Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, Nos. 260,008 to 510,007, and 560,008 to 580,007	5	..	..	8 %	8 %	7 1/16 — 7 1/8	7 1/16 — 7 1/8	7 1/8	7 1/32	..
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5⅜ — 6	5⅜ — 6	5 3/32	..	..
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	139 —142	139 —142	..	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	104 —106	104 —106	..	..	..
800,000	Babcock & Wilcox, 1 to 800,000	1	..	17 %	20 %	20 %	3⅞ — 4⅛	3⅞ — 4⅛	81/8	80/-	..
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..
88,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	7 %	7 %	5⅛ — 5⅜	5 1/16 — 5 1/8	5⅛	5 1/16	+ 1/16
40,000	Do. do. 7 % Cum. Pref...	5	Nil	Nil	7 %	7 %	6¼ — 6½	6¼ — 6½	..	..	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	6 %	6 %	5¼ — 5½	5¼ — 5½	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	4 %	4 %	4 — 4¼	4 — 4¼	..	..	..
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	101 —105	101 —105	..	..	..
200,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	..	100 —103	100 —103	..	..	..
800,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	6 %	125 —130	127 —132	129¾	..	+2
800,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	5 %	110 —115	108 —112 xd	..	..	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	108 —111	108 —111	109½	109½	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	102 —105	102 —105	..	..	..
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	103 —106	103 —106	..	..	..
188,301	British Electric Traction	10	8 %	6 %	6 %	3 %	4¼ — 4⅜	4¼ — 4⅜	9/-	87/6	..
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	8⅜ — 8⅝	8¼ — 8⅜	8⅝	8 1/8	+ ⅛
1,415,422	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	105 —108	106 —109	107⅜	107½	+1
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	85 — 88	85 — 88	86½	..	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6⅜ — 6⅞	6⅜ — 6⅞	..	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝ — 6⅛	5⅝ — 6⅛	..	..	..
600,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	94 — 98	94 — 98	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1 — 1⅛	1 — 1⅛	26/3	25/9	..
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	75 — 79	73 — 77	..	..	—2
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	3/16 — 5/16	3/16 — 5/16	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	2½%	¾ — 1	¾ — 1	..	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	6 %	1¼ — 1⅜	1¼ — 1⅜	88/6	..	..
125,000	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	95 — 97	95 — 97	..	..	..
125,000	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	82 — 85	82 — 85	..	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	3 %	2¾ — 3⅛	3 — 3⅛	66/-	63/9	+ ⅛
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	— ⅛
27,500	Do "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	4⅞ — 5⅛	4⅞ — 5⅛	..	..	..
317,700	Do 5 % Deb. Stock	100	..	5 %	5 %	5 %	105 —107	105 —107	..	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	102 —105	102 —105	..	..	..
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	8 %	7⅛ — 8⅜	7⅛ — 8⅜	8⅛	7⅞	..
32,610	Do. 105,001 to 137,610	5	..	..	..	8 %	7⅞ — 8⅛	7⅞ — 8⅛	7⅞	..	— ⅛
29,330	Do. 5 % Cum. Pref., Nos. 1 to 29,330	..	..	..	..	..	5¼ — 5⅜	5¼ — 5⅜	..	..	..
850,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4½%	4½%	103 —106	103 —106	..	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	15%	9⅜ — 10⅜	9¼ — 10¼	9⅜	..	— ⅛
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	5 3/16	..	..
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	103½—110¼	103½—110¼	..	..	..
491,222	Cape E. Trams., 1 to 491,222	1	15 %	10 %	6 %	Nil	1/16 — 1/8	1/16 — 1/8	11/-	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	6 %	1 3/8 — 1 5/8	1 1/8 — 1 3/8	28/3	22/9	— 3/16
280,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	97 —102	97 —102	100	..	..
1,989,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	83 — 85	83 — 85	84¼	83⅞	..
530,316	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	98 —100	98 —100	99	..	..
530,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	73 — 75	72 — 75	..	..	..
1,480,000	City and South London Railway	Stock	3½%	2¾%	2¾%	1¾%	41 — 43	41 — 43	42	41½	..
85,000	Crompton & Co., Nos. 1 to 85,000	5	5 %	2½%	2½%	2½%	1½ — 1⅝	1½ — 1⅝	..	..	..
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 999 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	94 — 97	94 — 97	..	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—(Continued.)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(continued).

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations Nov. 27th.	Closing Quotations †Dec. 4th.	Business done week ended Dec. 4th, 1906. Highest.	Lowest.	Rise + or Fall—
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	..	10 %	10 %	1 7/8 — 1 15/16	1 7/8 — 1 15/16	..	..	..
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	..	6 %	6 %	6 %	1 5/8 — 1 3/4	1 5/8 — 1 3/4	..	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½ %	4½ %	4½ %	103 —106	103 —106	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5½ %	6 %	6 %	14 — 15	14 — 15	..	..	..
59,987	Do. 6% Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14 — 15	14 — 15	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	Nil	2½ %	4½ %	1¼ — 1⅜	1¼ — 1⅜	30/-	..	..
17,139	Do. "A" shares, 01—017,139	5	Nil	Nil	2½ %	4½ %	2¼ — 2⅜	2¼ — 2⅜	..	..	..
344,028‖	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	..	..	..
100,000‖	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	Nil	3/8 — 1/2	3/8 — 1/2	..	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	7 %	7 %	7 %	7 %	1 5/8 — 2	1 5/8 — 2	..	..	..
900,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	83 — 86	83 — 86	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	9 — 9⅛	9 — 9⅛	..	..	..
900,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	91 — 94	94 — 97	..	..	+3
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %	3½ — 3⅝	3½ — 3⅝	..	..	..
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10½ — 10¾	10½ — 10¾	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	102 —103	102 —103	..	..	..
900,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	15 %	11⅞ — 12⅛	11⅛ — 12⅛	12 3/16	..	— ⅛
900,000	Do. do. 4½ % Pref.	5	4½ %	4½ %	4½ %	4½ %	5⅛ — 5⅜	5 5/16 — 5 7/16	..	..	+ 1/16
150,000	Do. do. 4½ Mort. Deb. Stock	Stock	4½ %	4½ %	4½ %	4½ %	108 —110	106 —108	107¾	106¼	—2
50,000	India-Rubber, Gutta-Percha & Telegraph Works.	10	10 %	10%	5 %	10%	17 — 18	17 — 18	17 1/16	..	..
87,500	†Liverpool Overhead Railway, Ord.	10	1½%	1%	1¼ %	Nil	1⅞ — 2	1⅞ — 1⅞	..	..	— ⅜
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	7 — 8	6 — 7	..	..	—1
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	3 %	7 — 9	8 — 8½	..	..	+ ⅛
892,930	Do. do. 50,008 to 100,000 (£6 paid)	10	..	8 %	6 %	3 %	3½ — 4½	8½ — 4½	..	..	..
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	8 — 9	8 — 9	8½	..	..
1,831,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	90 — 95	90 — 95	..	..	..
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	3 %	1/16 — 3/16	1/16 — 3/16	1/6	1/3	..
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/16 — 1/16	1/16 — 1/16	16/3	..	..
850,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½ %	4½ %	97 —100	97 —100	..	..	..
150,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 50,000	5	..	..	6 %	6 %	4 3/16—4 1/4	4 3/16 — 5	..	..	+ 3/16
24,500	Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	5 %	4 %	6 1/2 — 7 1/2	6 — 7	..	..	— ¼
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	7 1/2 — 8 1/2	7 1/2 — 8 1/2	..	..	..
345,000	Do. 4½ % Deb. Stock	100	..	4½ %	4½ %	4½ %	98½ —101½xd	98½ —101½	..	..	..
87,850	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	15 %	31½ — 33½	31 — 33	32½	31	— ½
150,000‖	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
8,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	90 — 92	89 — 91	91 1/8	91½	—1
640,000	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	3½%	99 —102	100 —103	100	..	+1
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	6¾%	3 %	Nil	Nil	3/4 — 1 1/4	1 — 1½	..	..	+ ¼
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	Nil	Nil	2 1/4 — 2 3/4	2½ — 3	50/-	..	+ ¼
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	75 — 80	73 — 76 xd	..	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	..	5 %	5⅓%	4 ⅝%	5 — 5½	5 — 5½	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½ %	4½ %	4½ %	99 —101	99 —101	..	..	..
22,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	10 %	8½ — 8¾	8½ — 8¾	8 7/16	..	..
10,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅞ — 8	7⅞ — 8	..	..	..
800,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	101 —104	100 —103 xd	102½	..	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %	3½ — 4½	3½ — 4½	78/9	..	..
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½ %	4½ %	4½ %	4½ %	4¼ — 5	4¼ — 4⅝	91/3	87/6	— ⅛
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½ %	4½ %	4½ %	4½ %	3¾ — 4¼	3¾ — 4¼	..	..	..
420,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —104	101 —104	101½	..	..
44,436	Chelsea Electricity Supply, Ord.	5	4½ %	5½ %	6 %	6 %	5¼ — 5⅝	5¼ — 5⅝	..	..	..
175,000‖	Do. do. 4½ % Deb. Stock Red.	Stock	4½ %	4½ %	4½ %	4½ %	106 —109	106 —109	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	6 %	9½ — 10½	9½ — 10½	..	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11 — 12	11 — 12	..	..	..
400,000‖	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	..	..	..
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½ %	4½ %	4½ %	4½ %	100 —103	100 —103	..	..	..
40,000	County of Durham Electrical Power, Ord.	2	4 %	4 %	£3 7 0	4 %	2⅛ — 2⅜	2⅛ — 2⅜	..	..	..
50,000	Do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½ %	5 %	8¼ — 8½	8 — 8⅛	..	..	— ¼
80,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10¼ — 11¼	10¼ — 11¼	..	..	+ ¼
400,000‖	Do. do. 4½ % Deb. Stock	..	4½ %	4½ %	4½ %	4½ %	107 —110	107 —110	..	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½ %	4½ %	4½ %	4½ %	99 —102	99 —102	..	..	..
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	4 %	2⅜ — 3⅛	2⅜ — 3⅛	65/-	58/9	..
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	4⅜ — 5¼	4⅜ — 5¼	100/-	98/9	..
320,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½ %	4½ %	4½ %	4½ %	99 —102	99 —102	..	..	..
10,000	Folkestone, 1 to 10,000	5	..	5½%	6½%	5½%	5⅝ — 5⅞	6 1/16 — 6 3/16	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	..	5 %	4⅝ — 5⅛	4⅝ — 5⅛	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	99 —102	99 —102	..	..	..
13,000	Hove, 1 to 13,000	5	..	5½%	6½%	5 %	7⅜ — 8¼	7⅜ — 8¼	8	..	..
31,000	∂Kensington and Knightsbridge Electric Ord.	5	10 %	12%	12 %	10 %	9¾ — 10⅜	9¾ — 10⅜	..	..	— ⅛
90,000	Do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	8	Nil	Nil	8	4 %	1⅞ — 2¼	1⅞ — 2¼	..	..	..
60,000	Do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4⅛ — 5¼	4⅛ — 5¼	..	..	..
674,396	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	5	7½ %	8½ %	10 %	10 %	7⅛ — 8¼	7⅛ — 8½	8	7 7/8	..
76,121	Do. 4½ % Cum. Pref. 1—71,106, £8 pd.	5	4½ %	4½ %	4½ %	4½ %	5 5/16 — 5 7/16	5 5/16 — 5 7/16	5 5/8	5 1/2	..
220,000‖	Do. 4½ % 1st Mort. Deben. Stock	..	4½ %	4½ %	4½ %	4½ %	109 —113	109 —113	..	..	..
250,000‖	Do. 3¾ % Mort. Deben. Stock Redem.	Stock	3¾ %	3¾ %	3¾ %	3¾ %	95 — 97	95 — 97	95 5/8	95 3/8	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½ %	4½ %	4½ %	4½ %	98 —101	98 —101	..	..	..
75,000	Newcastle-on-Tyne, 1 to 75,000	5	..	8 %	8 %	8 %	7⅞ — 8	7⅞ — 8	..	..	..
75,000	Do. 5 % Pref., 1 to 75,000	5	..	5%	5 %	5 %	5⅛ — 6⅛	5⅛ — 6⅛	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	7½%	13½ — 14½	13½ — 14½	..	..	..
64,000	Do. do. 4 % 1st Mort.Deb.	100	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	5	..	6½%	7 %	7 %	6⅜ — 6⅝	6½ — 6¾	6 5/8	..	— ⅛
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	98 —100	98 —100	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	12½%	9⅞ — 10⅜	9⅝ — 10⅛	..	..	— ¼
20,000	Do. do. 7 % Pref. 20,001 to 40,080	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..
150,000‖	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	4 %	1⅞ — 2¼	1⅞ — 2¼	..	..	..
60,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	73 — 77	73 — 77	..	..	..
65,000	South London Electricity Supply, Ord.	5	12½%	8 %	4 %	4 %	2⅜ — 3¼	2⅜ — 3¼	..	..	..
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	Nil	2½%	1/16 — 1/16	1/16 — 1/16	12/6	..	..
117,968	Do. Do. 7 % Pref.	1	Nil	7 %	7 %	7 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	25/8	..	..
200,000	Do. Do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..
50,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	3 — 3⅛	3⅛ — 3⅜	68/9	..	+ ⅛
80,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	4¼ — 4⅜	4⅜ — 4⅝	..	..	..
220,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	98 —101	98 —101	..	..	..
110,000	Westminster Electric Supply, Ord.	5	12 %	13½%	14 %	13 %	9⅛ — 10⅛	9 — 10	9 1/2	..	— ⅛
28,151	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	5 5/16	..	— ⅛
	(Originally 5%—Red. to 4½ % from 31st Dec., 1905.										

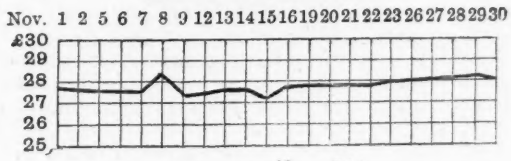
Shares not officially quoted:—Mackay Companies, ord., 74—76. Pref. 70—72.
† Unless otherwise stated all shares are fully paid. ‖ Interim dividends.

(Bank rate of discount 6 per cent. October 19th, 1906.

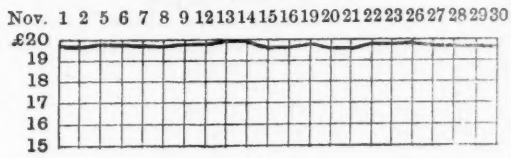
METAL MARKET.

Fluctuations in November.

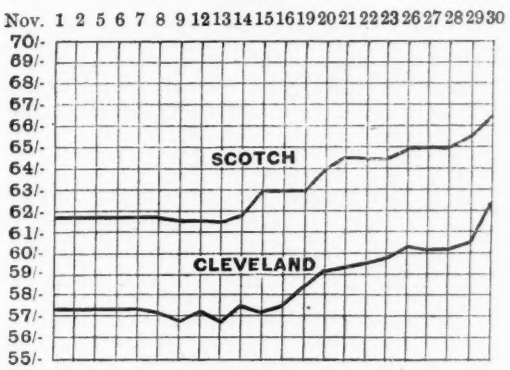
SPELTER (G.O.B's.)



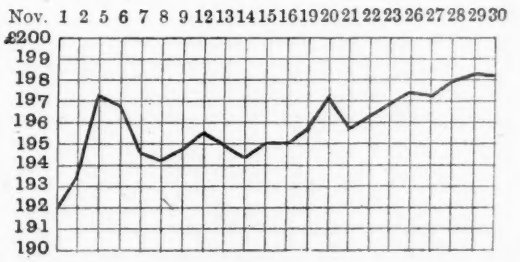
LEAD (ENGLISH)



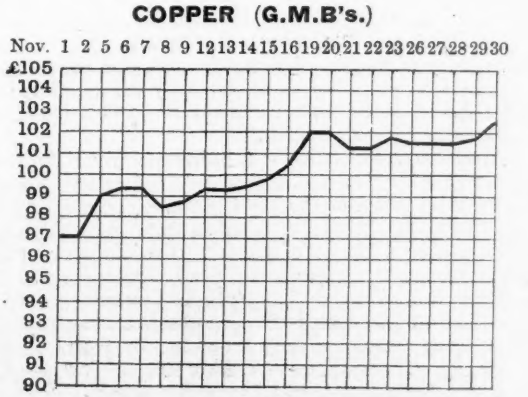
IRON.



TIN.



COPPER (G.M.B's.)



Italy.—The Societa Anonima Truffet has been formed at Milan with a capital of 200,000 lire, which may be raised to 1,000,000 lire. The object of the company is to manufacture electric apparatus, motors, &c.

SOME PRACTICAL NOTES ON THE COMMERCIAL DEVELOPMENT OF ELECTRICITY SUPPLY UNDERTAKINGS.

By R. BORLASE MATTHEWS, Wh. Ex., A.M.I.C.E.

Special Propositions.*

A reduction of rates will not increase business as much as systematic canvassing does, provided that the existing prices are not excessive. The reason that many people do not wire their houses, is chiefly on account of the fear they have that the cost of so doing will be out of proportion to the advantages derived, hence the importance of dispelling any illusions they may have on this point as soon as possible. The majority often do not even ask what the rate is; what they generally want, however, is an estimate of their probable monthly bill. They do not understand the rates as a rule, and knowing that the prices are the same to everyone, are satisfied if their neighbours use it the charge must be all right, so that to them it is all a question of installation cost.

Anything that can be arranged by the central station to reduce this initial investment, should be done. If the central station does not carry out house wiring, the local contractors should be supervised, to see that their work is done in the best and most economical way. That is, the central station should be prepared to act the part of a consultant, to advise upon a suitable installation and draw up a specification, and to arrange to inspect the work as it proceeds. The majority of wiring contractors consider that all they are called upon to do is to pass the insulation test required by the electrical authority, and that the smallest size wire or cable that will carry the current demanded without getting dangerously heated can be employed; at the same time they will often play upon the ignorance of a customer with respect to his fear of possible fire risk, persuading him needlessly to install, say, an expensive main switch or other device. Any tendency on the part of the contractors to talk of electrical fire risks must be immediately suppressed, as it is apt to do a great deal of damage to central station business. Though in some parts of the country the wiring contractors are up to date, intelligent and energetic, it must be admitted that such are the exception, and therefore the central station manager will find it necessary to educate them along the right lines for the proper development of new business, if the best results are to be obtained.

Local conditions and environment have a great deal to do with the suitability or otherwise of the application of any special propositions, and they must be borne in mind when considering the following notes.

Usually the most difficult case to deal with is that of the man who only rents, and does not own or lease the house he is in, for he does not feel justified in wiring, not knowing how long he will stay there, and his landlord often will not wire unless he can obtain an increased rent which is out of proportion to the enhanced value of the house due to the installation. As more and more houses in a town become wired, the landlords find that they have increased difficulty in letting the unwired houses; it is not, however, easy to make them see the advantage of wiring their property, until they are compelled to do so in order to let the house at all. If the landlord is obdurate, it is often advisable for the central station to get permission from him to install wiring in the house for a term of years and make arrangements with the tenant to purchase his own fixtures, and to pay a fixed sum monthly in addition to the charge for current consumed; this fixed sum being based on the interest and depreciation on the investment. As it is divided into monthly instalments the amount to be paid does not appear large, and the probabilities are that if a tenant should leave, the incoming one would also use the light. There are, of course, risks in undertaking work on this basis, but it is all helping towards the attainment of the day when it may be said that practically all the houses in the city are wired.

* Previous articles of this series appeared on pages 650-1, 656-7, 728-9, 808-9, 849-850, and 888-9 of the current volume.

The proper time, of course, to wire a building is when it is being built, as the cost is very little then, compared with what it is when the house is finished and occupied. So the attention of builders and architects should be constantly drawn to the desirability of wiring all new buildings for electric service. A tenant moving into a wired building, as a rule, uses the electric light without the need of canvassing, taking it almost as a matter of course that, as the wiring is there, it is intended to be used.

A certain class of people, when removing from a building in which they own the wiring, will tear the latter all out. To obviate this, as it necessitates persuading the incoming tenant to re-wire, it is a good idea to place a notice near the meter to the effect that, in the event of the occupant's removal from the building, the central station would be glad to assist them in disposing of the wiring to the next tenant, as in this way a better price could be obtained than if it were torn out, in which case it would only realise scrap prices. The name of the owner of the wiring should also be placed on this notice.

Having exhausted all arguments without succeeding in getting a tenant to wire, an attempt should be made to get him started with a partial electric service—something that will be universally appreciated, such as a porch light, which might be taken on a flat rate, for lighting up to, say, 11 o'clock in the evening. Flat rates as a rule, however, should be avoided, as they are extremely unsatisfactory both to the central station and the consumer, and lead to much bad feeling; in the case mentioned it is not so objectionable, as it is more of an advertisement.

The result of the installation of a porch light is that soon a light will be asked for in the hall; then is the opportunity for putting in a meter. The thin end of the wedge having been introduced, it will not be long before the occupant wants the rest of the house wired for electric light.

Another scheme worthy of consideration in getting electricity into a house is to make arrangements to install an electric flat-iron, a sewing machine motor, or fan.

In connection with the reduction of the cost of wiring for flat-irons and small motors to as low a point as possible, the following plan will doubtless prove of interest:—A board is prepared, about 4 ft. long by 10 in. wide, on which is mounted a standard two-pole switch and fuse box, a meter, a socket for a portable lamp, a switch and a socket for the flat-iron or motor leads. Such a board can be constructed very cheaply, and can quickly and easily be installed in a vertical position at the side of a window, the latter usually forming a convenient place of entrance for the service wires. The cost is less than that of wiring in the usual way, and if it is desired to remove the installation at any time, it has not depreciated in value.

In one city alone about 200 sewing-machine motors have been installed in this way. The users largely consist of people working for neighbouring factories who prefer to purchase a motor on the easy payment system and work at home rather than in the factory. A similar plan can also be adopted for introducing electric light into some of the smaller dwellings. Long flexible leads, or twin lead-covered cable, fastened by suitable clips to the wall and ceiling, may be used for carrying the current from the board to the living room and hall. Such an installation is only suitable as a temporary exhibit to show how convenient electric light is, and how little it costs, permanent wiring being much more satisfactory.

Occasional electric cooking lectures and laundry demonstration will be found a very effective means of impressing on the ladies the possibilities of electricity as an aid in the work of the household. Popular lectures on general topics are also useful.

A plan that might be considered is to arrange with the local ironmongers, jewellers and others to stock and exhibit certain classes of electrical appliances, the stock being supplied by the central station and sold at the same standard prices, and a commission allowed to the shop on each sale. The commission cannot, of course, be as large a percentage as is usually received on ordinary articles, since the shopkeepers are not investing their capital or running any risks of over-stocking, so a smaller commission is really quite as profitable to them. This scheme serves to further advertise and sell the apparatus, and at the same time keeps the prices at as reasonable a figure as possible, since the central station is really controlling the prices.

Information File.

An information file should be kept in the office, for the general reference of the staff, containing illustrations, data, and prices of special combined apparatus designed for operation with the electric current, such as coffee grinders, milk shakers, air-pumps for raising liquids, heating devices, &c. Such a file is very useful in assisting customers in the selection of labour-saving and, incidentally, current-consuming devices, therefore a special effort should be made to keep it well abreast of the times. It should be classified according to the uses to which the apparatus can be put, basing the classification on some well-known standard system such as an extension of Dewey's, which is employed by nearly every public library in the United States. A card index should also be prepared for use in conjunction with the file collection.

SHIFT ENGINEERS.

By W. MAYALL MILNES.

It is proposed in this series to deal with the shift engineer in the light of his qualifications, duties and responsibilities, and his position and remuneration.

I.—Qualifications.

As the name implies, a shift engineer should be an engineer, that is, one who has received an education as an electrical and mechanical engineer. First, he should be a mechanical engineer; secondly, he should be an electrical engineer; thirdly, he should have received a sound education in general physics; and, finally, he must be a good manager of men, which all engineers will readily admit is one of the most essential qualifications in a good shift engineer.

As to his mechanical education, he should have served an apprenticeship of not less than four years in an engineering works of some standing, though not one of the biggest shops, as there he will probably be engaged on repetition work, and although he may become an expert in the construction of a few parts of one form of machine, he will know little or next to nothing of general engine and machine construction.

On the contrary, if his apprenticeship is served in a works employing from 400 to 1,000 men, where both engine and machine construction and repair work are done, and if possible one where electrical machinery is also made, he will be moved about from one job to another, sometimes on constructional work, at other times on repair work, and perhaps occasionally he will be sent out to assist in the erection of machinery at its destination.

In this way he will receive a thorough insight into the construction of engines, their peculiarities, and the troubles they are most subject to, which is exactly the knowledge he will find most useful when he comes to take charge of an engine room, be it large or small.

Then as to his electrical qualifications: after finishing his apprenticeship, he should get into an electrical engineering works, if he has not already had this experience, or if he has, then into a central station as an improver or dynamo attendant, for a couple of years. Here, in view of his practical knowledge, he will be given repair work to do, such as overhauling engines, dynamos, motors, and such alterations to the station wiring as become necessary, thus obtaining a useful working knowledge of power station machinery. He should have at least 12 months' experience as a switchboard attendant, in order to get a thorough acquaintance with switchboard construction and control.

His practical training will then be sufficient to fit him for a position as shift engineer.

With regard to his technical education, he should have a good knowledge of mathematics, sufficient chemistry to make the coal, CO_2 and such like tests required on the station,

a thorough knowledge of such subjects as steam (with a practical acquaintance with indicating and indicator cards), applied and theoretical mechanics, machine drawing, and electrical engineering calculations, and he must be able to apply these to the problems of his everyday work.

These may at first sight appear rather a large order for a young engineer of 25 or 26 years of age, who has not had the benefit of a college training, but anyone who has devoted a fair proportion of his evenings during the earlier part of his training, say for five or six years, to systematically attending evening classes at the technical schools, will have experienced no great difficulty in mastering the lot, as is proved by the fact that many young engineers are nowadays met with who have not attended any college as day students, but have nevertheless gained their B.Sc. engineering degree.

The most difficult qualification of all to obtain, and one of the most important for the shift engineer, is the ability to manage men successfully. This is the one most often found lacking in young engineers, and as only a few are naturally endowed with this gift, the majority have to cultivate it. Firmness and tact are the two essentials, treating every man, from switchboard attendant to coal trimmer, with as much kindness and consideration as is consistent with the discipline necessary to run the important and expensive machinery under his control economically and successfully, a result which is only secured by the hearty co-operation of the men whom he has under him.

Of course these qualifications in young engineers are not met with every day, but they are most certainly those that every man who is, or who hopes to be, a shift engineer in charge of expensive electrical machinery, should strive to equip himself with, as far as his own powers and natural abilities will permit.

The next article will deal with the duties and responsibilities of a shift engineer.

INTERESTING APPLICATION OF MOTORS TO EXISTING MACHINE TOOLS.

Under the above heading an American contemporary, the *Electrical World*, gives particulars of the change from shafting to electric motors for driving the engineering works of the F. Wesel Manufacturing Co., of Brooklyn. The chief interest attaching to this installation is derived from the adoption of separate motors for machines requiring very small powers to drive them, and many of which are arranged in suitable groups for the advantageous application of shafting for their operation. The motors vary in size from $\frac{1}{10}$ H.P. to 15 H.P., and 192 are in use, only nine of which exceed 5 H.P. in size, 161 being of 2 H.P. or less. All the motors with one or two exceptions run at constant speed, variations being obtained by the usual stepped cone pulleys.

Before deciding to adapt motors to their existing plant, the Wesel Co. obtained prices of new machines of the motor-driven type, but it was found that the motors could be purchased separately, and fitted to the tools for much less money than was asked for the combined machines, and as much of the plant was still serviceable, motors were purchased, and applied to both new and old machines alike. Considerable ingenuity was displayed in scheming the supports for the driving gear and switches, which are mounted upon the usual variety of machine tools to be found in an engineering works devoted to the production of small machinery.

The cables are protected by conduits, and the wires to each motor are carried in flexible metallic tubing. The switchgear in each case includes provision for cutting out the lamps, and push-button emergency switches for promptly stopping the machines. All the motors are of the totally enclosed type.

The lighting throughout the works is effected mainly by glow lamps with the assistance of a small number of enclosed arcs, the current for this purpose being taken from a separate set of bus-bars.

The power station includes two 100-KW. 240-volt direct-current generators coupled to two 150-H.P. high-speed engines, and a storage battery having a capacity of 40 amperes for eight hours, is installed to supply energy for lighting after the generators have been shut down.

The advantages claimed include the better light obtained through the absence of overhead shafts and belts, and economy of floor space by the arrangement of the machines in the most advantageous manner.

Economy in power is also stated to have resulted from the change, and this contention would appear to be substantiated by the facts given. The aggregate horse-power of the motors amounts to 400, and the average load of the generators is given as 150 H.P. Experience in this country where large machines have separate motors and small ones are driven by shafting indicates that the average power required equals about half the total rating of the motors connected, on which basis the Wesel Co. would save 25 per cent., they state, however, that 300 H.P. would be required to drive the machinery by shafting and belts, thus making the saving equal to 50 per cent., which would no doubt be sufficient to cover the additional capital charges and leave a handsome margin.

The question of fitting motors to small machines is an interesting one, and the more the data obtained from examples of this kind, the sooner will the problem be solved of how far the principle should be carried in any particular case.

The advancement towards perfection in the two rival methods must not, however, be overlooked, electric motors, as regards efficiency and absence of friction in the connecting gear, have pretty much reached finality, and the results of ordinary shaft driving with countershafts running in plain bearings are sometimes compared with those obtained from the separate motor system, as has been done above. But if the shafting were fitted with ball bearings and countershafts were dispensed with by the aid of magnetic or other friction clutches, much less power would be required to drive by this means, and a comparison on this basis with separate motor driving would be most instructive.

The question will only be settled by the help of experience, and it is to be hoped that engineers with practical knowledge of the working of either system will make known the results for the benefit of their *confrères*.

PROCEEDINGS OF INSTITUTIONS.

Institution of Electrical Engineers.

REGENERATIVE CONTROL OF ELECTRIC TRAMCARS AND LOCOMOTIVES.

By Alfred Raworth.

(*Abstract of Paper read before the* Leeds Local Section *at Sheffield, November 22nd,* 1906.)

Actual experience has shown that even on level lines, regeneration produces a saving in current of over 10 per cent., and wherever the country is undulating, from 20 to 30 per cent. may be expected.

As a brake the regenerative motor is unsurpassed, because the retarding effort whilst very strong, is completely under control and is free from objectionable jerks.

Many of the advantages of regeneration were clearly foreseen by Sprague so early as the year 1885, but at the time of Sprague's experiment no motors would run with a fixed line of commutation, and the position of the brushes had to be changed when the motors were reversed. This condition was, of course, fatal to any proposition for producing regeneration.

The first attempts in the direction of developing the present system of automatic regenerative control were made at Devonport in the autumn of 1903. The result of the experiments was to show that the system was perfectly practical even without the advantage of putting the motors in parallel. The range of speed, however, was somewhat limited, and was particularly noticeable in hill climbing; consequently, with a view to removing this, several attempts were made to devise a series-parallel controller.

A satisfactory controller was eventually produced, and is now in operation on some 45 cars.

The difficulty of changing from series to parallel or *vice versa* with shunt-wound motors, consists principally in the fact that the speed of the armature varies inversely as the strength of the field and directly as the voltage across the brushes. It is obvious, therefore, that in changing from series to parallel the field strength must be practically doubled, otherwise the moment the armature circuit is closed across 500 volts a violent attempt will be made by the motors to accelerate the car. The operation of strengthening the field can be carried out fairly quickly, but not quite quickly enough; consequently it is necessary to insert some resistance in series with

the armatures to check momentarily the rush of current. It is also necessary to insert some series field winding in series with each armature, for without this precaution the motors would not work in parallel.

It is also an essential condition that in breaking the current either when going out of series or when coming out of parallel, there shall be no resistance in circuit, otherwise there will be heavy flashes in the controller. In this respect shunt motors differ entirely from series motors, in combination with which latter resistances are necessary when opening the circuit.

Apart from this little difficulty, the operation of this controller is simplicity itself. It first puts on the shunt field, then closes the armature circuit through resistances which are cut out in steps, weakens the field to increase speed, doubles the field strength and puts the armatures in parallel, a small series winding being in series with each armature and resistance in the main circuit. This resistance is then cut out in steps, and the field again weakened to attain the top speed.

The series of operations is shown in fig. 1, which is a diagram showing the connections on each notch of a series-parallel controller arranged for working two motors.

Referring to this diagram, it will be seen that the shunt field circuit is first closed; then on the first notch the armatures are connected in series with resistance. The resistance is then cut out in steps, and on notch No. 4 the armatures are in series across the full voltage, the shunt fields being fully excited. This notch gives a speed of from 3½ to 6 miles an hour, according to the type of motor used. It is an advantage to have the minimum reactive speed as low as possible, both for the sake of economy in current due to the reduction of the rheostatic period and because it is the minimum speed at which the motors will return current to the line.

On Notches 5 and 6 resistance is inserted in the shunt field circuit with the object of increasing the speed, the speed on the sixth notch being 3 or 4 miles an hour faster than the minimum reactive speed.

On Notches 7, 8 and 9, when the controller handle is being turned in a clockwise direction, the connections are exactly the same as on Notch 6. Thus, when the circuit is opened preparatory to going into parallel, there is no resistance in the armature circuit.

On Notch 10 all the resistance in series with the shunt fields is cut out, thus giving the maximum field strength, the armatures are connected in parallel, each in series with its series field winding, and resistance is inserted in the main circuit.

A resistance is put in parallel with the series windings in order to shunt a portion of the current; only so much current as will balance the load between the two armatures is allowed to pass through the series windings.

On Notches 11 and 12 the resistance in the main circuit is cut out in steps, and on Notch 13 the armatures are in parallel across the full voltage, the field strength being at the maximum.

On Notches 14 and 15 resistance is inserted in steps in the shunt field circuit to attain the top speeds.

Now, when the controller handle is turned in a counter-clockwise direction, the same combinations as when accelerating are made as far as Notch 13, and the speed is reduced from the maximum down to a speed which is only slightly more than double the minimum regenerating speed in series. But on Notches 12, 11 and 10, the connections are exactly the same as on Notch 13, and when the circuit is opened preparatory to going into series there is thus no resistance in series with the armatures.

On Notch 9 resistance is connected in series with the shunt field windings and the armatures are connected in series, in series with resistance. On Notches 8 and 7 this resistance is cut out in steps until on Notch 6 the armatures in series are connected across the full voltage.

On Notch 5 the resistance in series with the shunt fields is reduced, and on Notch 4 it is cut out altogether.

At this point the speed of the car has been reduced to the minimum regenerating speed. The handle is then shut off in the usual manner and the hand brake applied. But when moving the handle from Notch 4 to the off position, the resistance which was inserted on Notches 1, 2 and 3, when moving in a clockwise direction, is kept short-circuited, thus again providing for the opening of the circuit with the armatures connected across the full voltage.

The rheostatic brake Notches 1, 2 and 3 make connections similar to those used for the same purpose in ordinary controllers; these notches in the controller coincide with the power Notches 15, 14 and 13.

One of the contact rings is loose on the main cylinder, and is driven by a pin working in a slot, which enables the loose ring to lag behind the main barrel by the space covered by three notches.

If the controller is moved, say, to Notch 6, and then back to the off position, the slip contact hangs back three notches behind the rest of the main cylinder; thus the resistance in circuit on Notches 1, 2, 3, 10, 11 and 12 is short-circuited when the controller handle is being turned in a counter-clockwise direction. In the same manner the resistance in circuit on Notches 7, 8 and 9 is short-circuited only when the handle is turned in a clockwise direction.

The present form of controller has only been in existence 12 months, but we have about 100 of them working successfully.

Twelve months after the commencement of the experiments with series-parallel working, there were 14 cars running with series-parallel control on the Yorkshire Woollen District Tramways, and they have never given any trouble.

It can be taken as a fact that any motor which is good when series-wound is good also as a regenerative motor.

From the foregoing part of this paper it will have been understood that each notch on the controller corresponds to a definite speed, which speed varies only within small limits. So long as the controller handle is left on any one notch, the car will run at the speed corresponding with that notch, practically irrespective of gradients. It will be seen, therefore, that if a driver be running on the sixth notch at, say, 6 miles an hour, and then brings his controller handle to Notch 4, which we will say corresponds with 4 miles an hour, the speed of the car will at once be reduced accordingly. If the car at the time be ascending a gradient, the

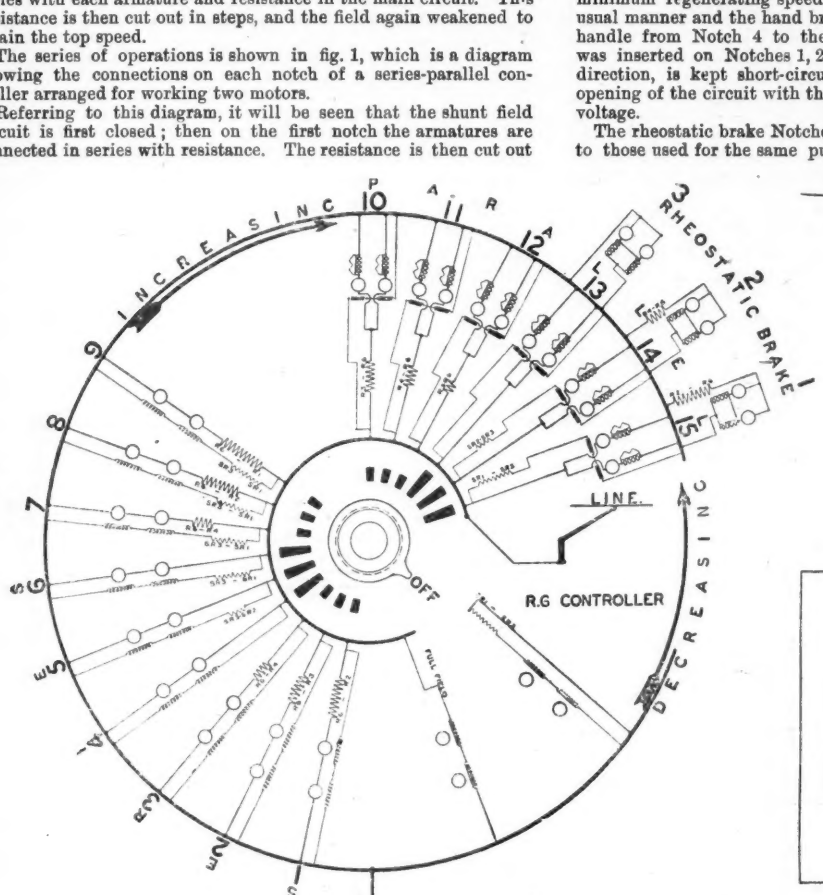


Fig. 1.—Diagram of Connections of Controller.

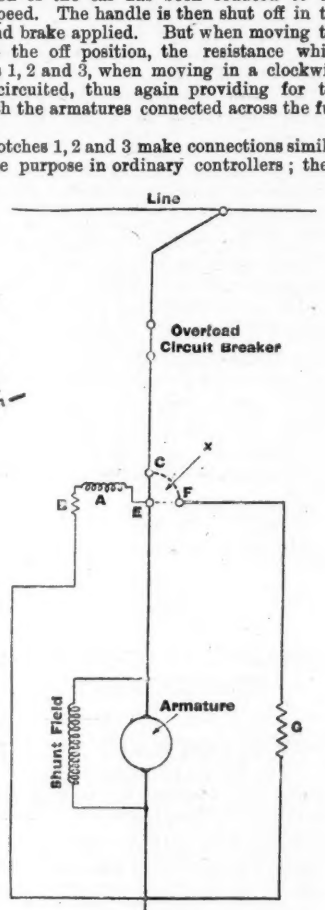


Fig. 2.

armature current will be reduced; if it be descending a gradient, or running on the level, the back E.M.F. of the motors will exceed the line pressure, and the motors will return current to the line. The driver has, therefore, always under his control a most powerful braking effect, which is produced without any physical exertion on his part.

Most tramway accidents are caused by a car approaching a falling gradient at a speed greater than that at which it is desired to descend. The wheels are locked by the hand brake, or the electric brake may not build up owing to a dirty commutator, or a dirty controller. The result is only what one would expect—the driver loses his head, and an accident follows.

But a regenerative car may drift on to a down grade in the same way, but with this difference, that the speed is constant and can be reduced by the ordinary movement of the controller handle, no part of the equipment and no single piece of cable being used which is not also used to propel the car. The car cannot accelerate and therefore cannot get out of hand.

Until lately, however, there was one objection to the regenerative method of braking. If a car were descending a grade, and from any cause were cut off from the source of supply, the braking effect would be immediately lost; also the driver in shutting off his controller might produce momentarily the combination of a strong field and a high speed, thus allowing the motors to generate a voltage which has destroyed a considerable number of lamps and not a few station voltmeters.

Both these troubles have, however, been cured, or rather prevented, by the device shown diagrammatically in fig. 2. Suppose a car to be descending a gradient at, say, 6 miles an hour, and suppose also that while so doing the trolley comes off the wire, there is a tendency for the voltage across the motors to increase; directly this happens, the current in the coil A increases and trips the switch X, so establishing a circuit from contact E to F, and then through the resistance G to earth.

In actual practice it is found that should the supply be interrupted as explained above, a car can be brought to a speed as low as 2 miles an hour by the ordinary movement of the controller handle, the regenerated current passing through the resistance G instead of along the trolley wire. Thus the regenerative brake is not dependent for its action upon the continuity of the supply circuit.

There are therefore four most valuable claims for the regenerative brake:—

1. It cannot, under any circumstances whatever, or with any condition of the rails, lock the car wheels.
2. If it is out of order, the car cannot be moved.
3. It is not dependent on the continuity of the supply circuit.
4. The more you use it, the less it costs; in fact, it pays you to use it.

The saving in current varies according to the contour of the route, conditions of traffic, &c. On level lines it is small, but on hilly lines it may be as much as 30 per cent.

Comparative current consumption tests on cars are given below, which were usually made with special cars unloaded; but at Devonport the meter was fixed on cars running in service.

A special point of interest in the Penge test is that the total current taken by the regenerative car, *before deducting the regeneration*, is 6·5 per cent. less than the current taken by the series motor-car.

A number of temperature readings which have been taken on regenerative motors after service runs on several roads are also given.

Official tests taken at Bristol, March 14th, 1906, on the Bristol Tramways and Carriage Co.'s system, with a B.T.-H. 75-ampere watt-meter:—

Car 105.—Equipped with Raworth's R. 3 type series-parallel controller and two G.E. 58 regenerative motors.

Car 181.—Equipped with B.T.-H. B. 18 type series-parallel controller and two G.E. 58 series motors.

Condition of rail.—Wet.

Distance travelled by each car 44·18 miles.

Car 105.—Average current consumption per car-mile, ·871 unit.

Car 181.—Average current consumption per car-mile, 1·15 units.

Showing a saving of 24 per cent. in favour of the regenerative car.

South Metropolitan Tramways Co., Ltd.—Official tests taken with two 75-ampere B.T.-H. car watt-meters mounted on suitable springs, &c., on July 4th, 1906, on two cars similar in every respect except the equipments, No. 4 car being equipped with 1,202 B. regenerative motors and R. 3 controllers, No. 10 car with 1,002 B. Brush motors and 3 A. controllers:—

Saving by regenerative car, Crystal Palace route, 28·25 per cent.

Saving by regenerative car, Penge route, 24·30 per cent.

Average saving by regenerative car, 26·70 per cent.

Tests taken at Devonport, March 14th, 15th and 19th, 1906, on the Devonport and District Tramway Co.'s system, with a B.T.-H. 100-ampere watt-hour meter:—

Car No. 21.—Equipped with Raworth's R. 3 type series-parallel regenerative controllers and two 1,002 B. regenerative motors.

Car No. 15.—Equipped with B.T.-H. K. 10 controllers and two G.E. 58 (six-turn) motors.

Saving in current consumption by No. 21 car = 28·7 per cent.

During tests both cars were running in service, and conditions of rail, traffic, &c., were exactly similar.

Temperatures of Regenerative Motors, in Degrees Fahrenheit.

Tramway system.	Atmosphere.	Series field winding.	Shunt field winding.	Armature winding.	Commutator.	Time in service and section.
South Metropolitan Tramways.	63	142	164	159	155	14¾ hours on Selby Road and Penge.
Devonport and District Tramways Co.	57	106	106	112	128	10 hours on Tor Lane and Fore Street.
Yorkshire Woollen District.	68	125	126	145	175	14 hours on Dewsbury and Cleckheaton.
Bristol Tramways and Carriage Co.	53	139	168	147	151	14 hours on Knowle and Bristol Bridge.

The saving in current as measured on the car is by no means the whole of the purely electrical savings effected by regenerative control.

The diminished output from the generating station implies diminished losses throughout the whole feeder system, and as the losses vary as the square of the current, reducing the latter by 20 per cent. reduces the line losses by 36 per cent. An original loss of 10 per cent. would therefore become 6·4 per cent., and this in the case of a system with an output of seven million units yearly at 1½d. would mean a saving of £1,575.

Again, the maximum demand on the power station will be very much reduced and the variations of load will be less than with series motor-cars.

The actual mean load is at the same time diminished, with the result that probably one-fourth of the generating plant could be shut down, the car service remaining as before. At the same time the remaining generating plant would be more uniformly loaded and, therefore, more economical.

A considerable saving may also be obtained by the reduction in the maintenance charges on trucks, wheels and brakes. This is due to the fact that the regenerative brake is always made use of in regular running, thus to a great extent relieving from duty the hand and other mechanical brakes. Not only is the continual setting, repairing and replacing of brake gear done away with, but brake blocks, which ordinarily wear only a few weeks, will last several months, records being available which show a life of from 20 to 30 thousand miles.

As the grinding away of the wheels, due to the application of the brakes, is also done away with, the life of the wheels is considerably increased. Even in hilly districts the figures which we have obtained from users of the system indicate a life of about 60,000 miles for chilled wheels with regenerative control, which is about double the life under ordinary conditions.

The automatic action of the regenerative control brake for regular running also does away with the chief causes of flatted wheels.

Now, to take an example of what these savings would mean to a tramway undertaking running, say, 250 cars, and using, say, 10,781,227 B. of T. units yearly.

The cost of current at ·8d. per unit would be £44,920.

Assuming now that this sum would be reduced 25 per cent., an annual saving of £11,230 would be effected.

The saving in costs for repairs and maintenance we will assume is £15 per car per annum for trucks, wheels and brakes—a fair estimate, I think, but possibly a little low.

The total yearly saving, therefore, in current, and in repairs to trucks, wheels and brake gear, would be £11,230
3,750

£14,980

—enough to pay for the conversion of all the cars in two and a half years.

Discussion.

Prof. Crapper, in opening the discussion, said they must all congratulate Messrs. Raworth on their ingenious solution of the problem. He would like to know whether a motor of given horse-power would do the work and not exceed the working temperature which had been fixed as the standard for the rating of motors, *i.e.*, 100° F. above the surrounding atmosphere.

Mr. A. R. Fearnley (Sheffield) said, regarding the temperatures, these were at least 25 per cent. higher than what they got with series motors on the Sheffield Tramways. If they were going to have a saving of 10 per cent. in current, and in turn an increase in renewals and maintenance, there was going to be little or no gain in adopting the regenerative system. With reference to the author's statement that it was possible to obtain 60,000 miles from chilled wheels with regenerative control, he would be very much interested to hear where they were getting these results with chilled wheels of any description, as it was a considerable improvement on his experience in this direction. He did not agree with Mr. Raworth respecting the safety of cars equipped with regenerative equipment, as, in his opinion, there was exactly the same danger with this type as in coasting with a magnetic track brake.

Mr. Acland (Chesterfield) asked the author how the acceleration of these cars compared with the ordinary series-parallel control, and how the Board of Trade viewed the system—whether they permitted the use of only the hand brake with the regenerative control, or whether they also insisted on a third brake for emergency. He would like to know what would be the effect on the generator if several of these cars in parallel were running downhill, and tending to run the generator as a motor, as might be the case on a small system. At Chesterfield, when there were only six or seven cars on the line, the load often fell to zero. While he considered the magnetic track brake to be one of the best from the safety point of view, it undoubtedly put much more work on the armature, resulting in higher maintenance costs. If motors were to be used almost continuously either as motors or generators, the ordinary rating must be decreased and larger motors used, or the upkeep would be very much higher, the same remarks applying to both the regenerative control and the use of the magnetic as a "service" brake. The most important point appeared to him to be the "braking" power of regenerative control. Regarding the automatic cut-out carried on the cars, he understood that if a car was coming down a gradient and the trolley came off, this arrangement was brought into action when the voltage on the motors (running as generators) rose to 600, putting the other pole to "earth" through a resistance, and using the motors in the ordinary way as a rheostatic brake; but if the commutators were not clean there seemed to be a danger, with the increased voltage, of flashing over before the coil on the automatic switch had time to operate, which would give a condition very productive of skidding on a greasy rail.

Mr. Yerbury (Sheffield) wrote that it appeared to him that the change from ordinary series control to series-parallel had been the salvation of the regenerative system. From a theoretical standpoint, the system might be called ideal, for they were all anxious, not only for the safety of passengers, but that the motormen should be relieved as far as possible from the manual labour entailed in the application of the ordinary hand brakes, for he looked upon the saving in current consumption as of secondary importance when compared with the advantages of an easy, safe and economical method of control. Respecting current consumption and the saving effect of regeneration, it appeared to him to be reduced to a somewhat fine limit, as he understood that a car must be travelling over 4 miles per hour before any useful regenerative effect was attained, and when the voltage from the motors increased up to, say, 600, the useful effect of regeneration was cut off by the automatic switch, which he was told now effectively prevented the original troubles, such as burnt-out lamps, opening of circuit-breaker at power station, occasional reversals of generator polarities, and other irregularities of a disturbing character. He was somewhat surprised to note that on one test at Penge it was found that 25 per cent. less current was taken by the regenerative car (ignoring the regenerative effect) than by the series-motor car. As he had yet to learn that a shunt-wound motor was more efficient than a series motor, he would like to ask Mr. Raworth whether this reduction was brought about by the more rapid rate of acceleration. He was inclined to think that the controller handle on a regenerative car would need more careful manipulation than on the ordinary series-parallel equipment, and he would like to ask Mr. Raworth the estimated life of a motor with a commutator and coils working at a temperature of over 100° F. above the atmosphere. He was of opinion that the best results (including reasonable life) would be attained by having larger motors and, if possible, ventilated carcasses.

Mr. E. A. Paris said the company he represented had 14 cars equipped with the first series-parallel controllers. The unfortunate conditions under which the system was worked had up to the present prevented them from fully profiting from the advantages which undoubtedly were a feature of this system. Power was taken from four different authorities who had different units of plant. In one authority's boundary equipped with accumulators they had no trouble, but in all the others they had more or less, principally more, trouble owing to the return current, so that they had to coast down the hills to prevent the back current-breakers from coming out. A good many lamps had been broken in consequence of the high E.M.F. generated as soon as the station breaker came out, but all these ills were to be an experience of the past, as soon as the apparatus shown in the paper was installed. They had very little repairs and adjustments to make, and when they were in full swing and free from the station troubles, a current saving, as well as a considerable saving in wear and tear of brakes and of labour, would no doubt result. As only a fifth of the cars were fitted, the saving in current over the whole system did not amount to more than about 5 per cent., if as much; taking current at 1·5d. per unit, they should save 75,000 units, or roughly, £464. The saving, however, in other directions should make this figure quite acceptable as a set-off against the extra outlay. One important point about cars equipped with this system of control was that they were far less liable to collisions. The car was kept better in hand than was the case with the ordinary series-parallel controller, where they had always to be at the hand brake. He did not think that they had had any collisions with cars fitted with regenerative control.

Mr. Baylor said it seemed to be the general opinion that the operation of the regenerative system introduced certain disadvantages that series-parallel control did not possess. As a matter of fact, ever since traction motors had been in general use, every engineer had had his eye on regeneration. The early motors could not be handled in this way, because of excessive heating and sparking. Although the motors must heat more than they would with ordinary series-parallel control, this heating did not extend into a dangerous zone. In fact, the heating and sparking difficulties had practically disappeared, and it was possible to take advantage of the great saving in current and also in wheel and brake wear and tear without attendant disadvantages. The Crystal Palace line was very steep, and at the foot of the hill there were a series of switchback intervals, which gave an opportunity of showing the regenerative effect particularly well. On a hilly line like this the additional safety due to regenerative control was especially emphasised. As to the handling of the controller, the men became accustomed to the equipment, and would not bring their handles back too quickly. If a man were to do so, he would probably be thrown over the dasher into the street, and would not want reminding of it again. The men themselves much preferred the regenerative control. He was perfectly satisfied that in a very few years regenerative control in some form would be absolutely universal in tramcars.

Mr. William Baxter wrote that if the full field speed of the rewound motors was kept down to the same figure as when series wound, it was very difficult to see how a greater temperature rise could be avoided. In this connection the temperatures given were of little or no value without corresponding figures for series-parallel motors running on the same routes. Again, unless the rewound motors were fitted with commutators having an increased number of segments, the sparking constants when running on notches 14 and 15 would not be as good as they were before rewinding.

Mr. Goldston said that, having personally operated both kinds of cars, he was, perhaps, in a better position than most people to speak as to their performance. With regard to the difficulties in operating, no matter what kind of rails or gradients they had, they could get practically the same results with a regenerative car as they could with a car fitted with ordinary series-parallel control. Running down hills, the effect of the regenerative car was, of course, to give the motorman every confidence, as on descending a hill the controller was not switched off, but was still kept on one of the running notches according to the speed required. The car would then travel down hill at the same speed as it would on the level, or uphill. The fact of the car not accelerating when it got over the brow of a hill was a great point in the matter of safety. When descending very steep hills, if they had track brakes on the car it was just as well to apply them, because if the gradient was very steep, say, 12 or 13 per cent., the wheels were liable to slip (not skid). On ordinary hills this effect was not so serious. Regarding the life of the motors, they found the latter had slightly higher heating than the ordinary series-parallel type; but with a Brush 45-H.P. motor, rated at 125° F. temperature rise after one hour's run at full load, they found that in a number of experiments which they carried out, the temperature of the shunt winding got up to 150° F., and that of the armature to 160° F. With the ordinary series-parallel controller fitted on an exactly similar car, and running over the same road, the temperature of the armature winding was 120° F. and the temperature of the field winding 100° F. The number of hours that the car ran was 15. The difficulties which they had with the armatures with regenerative control were of little moment, and they never had an armature burnt out with this system. Also, they had never had an armature burnt out through any electrical fault on a car fitted with Westinghouse brakes. With regard to maintenance, a very considerable saving had been effected, such as the upkeep of brakes and other parts which had to be looked to every day. With the ordinary series cars running on some of the worst routes the brake blocks lasted from five to six weeks. The cars did not run every day, but every second day, and there was practically a double shift, but with the regenerative cars he found that brake blocks lasted from five to six months, which was a very big saving both in material and labour. The adjustment of the brakes of an ordinary car had to be carried out on an average about every day, but on cars fitted with regenerative control only about once a week. They were, of course, examined every day, but adjustments were not necessary. They had four power stations to deal with, and four different systems of supply. With one of them, which consisted of shunt machines with a battery and booster, they had no trouble, as the regenerative cars when returning current simply charged the battery. The other systems had compound machines without batteries, and one of them had the reverse current breakers set to a very sensitive degree so as to come out at 15 or 20 amperes of reverse current. In consequence of this, regenerative cars were not run on this section. In the other two the reverse breakers were not nearly so sensitive, and therefore not very liable to open. Although the current was sometimes cut off, they had never experienced any ill-effects as regards safety. The motormen were aware of what had happened, and applied the ordinary brakes and pulled up. In addition to the ordinary brakes (hand and track) there was the rheostatic brake similar to that fitted to the ordinary series-parallel cars, which could be used when the current went off.

Mr. Wraith said: To get over the heating was only a matter of increasing the quantity of material in the motor. If Mr. Raworth had trouble with sparking and flashing on the motors, he thought the electrical design of the motors was at fault, and this should be easily remedied. It would be very interesting to hear how the capital cost of the regenerative control equipment compared with that of the ordinary series-parallel system.

Mr. King said: He would like to ask Mr. Raworth how the conditions of service affected the amount of energy returned to the line. In Sheffield the gradients were very steep and of considerable length, some of them 2 miles, but still the cars had to stop very frequently, and under these conditions they would not get so much energy back to the line as might be expected from the gradients.

[Messrs. Raworth's reply has come to hand, too late for inclusion in this issue.—Eds. E.R.]

The Third Function of Electric Traction Motors.

AT the fourth meeting of the fifty-first discussion session of the Manchester Association of Engineers, held on Saturday evening, November 28th, Mr. EDWARD H. JOHNSON, of London, read a paper on "The Third Function of Electric Traction Motors." Mr. Johnson's opening described the various types of electric traction motors and methods of motor control at present in use. In regard to the new regenerative system, he said his specific purpose was to dwell upon the evolution of this newly-fledged attribute of the electric motor. He used the term advisedly; for although the attribute *per se* was not new, it was, nevertheless, just emerging from the chrysalis stage into the sphere of developed things. The phenomenally rapid growth of electric traction, resulting in its practically universal adoption for tramways, and its hardly less general use in all short-haul railway traffic, was due rather to an all-round superior fitness than to any one pre-eminent quality. Being economical in operation, easily extended and time-saving, it had created a revolution in local transit. That industry was no longer relegated to small private capital, but was now raised to the dignity of "trust" combinations, with, so to speak, a seat on the world's financial exchanges. In fact, electric power was so inherently cheap that suggestions of further cheapening it had been pooh-poohed, but there were signs of a dawning consciousness that dividends might be substantially increased by cheapening even that which was already cheap. There was a still more potent force at work than even the economical one for developing a demand, albeit unwittingly, for the more complete utilisation of the motor's functions. This was the voice of public opinion, which having been raised in consequence of multiplying accidents was now demanding greater care for safety in operating. The electric vehicle had grown great in itself even as it had multiplied, while the gradients had, for obvious reasons, remained practically unchanged. The dangerous conditions thus created had not been met by a corresponding development of the braking and other safety factors, a fact now becoming apparent. He proposed to show, in response to a dual inquiry, how the motors themselves might be made to yield proximate finality in these respects by combining in a practical and workmanlike manner all three of their inherent functions. In the development of the series-compound regenerative system, he had the invaluable services of Mr. Robert Lundell, of New York, and Mr. Gustaf Lang, of London, the aim being to evolve practical means for embodying only such factors as were inherently efficient and economical both in theory and in practice. A fundamental aim was to relegate shunt excitation to the single duty of regenerating, in which duty alone it was indispensable, and at all other times to operate the motors under series excitation simply. In realising this aim it had been found practicable to retain in a regenerative system the inherent advantages of the standard series traction motor, and to avoid the losses and incidental disadvantages of shunt excitation. The field windings were so proportioned as to produce the right resistance and current-carrying capacity to yield the practical limit of magnetisation, both when the coils were connected in series across the full line voltage and when grouped in parallel and in series with the armatures. It was at the same time essential that there should be no idle copper or waste field space, that was to say, the maximum attainable magnetisation limit must be reached with an irreducible minimum of field copper and motor dimensions, otherwise both cost and dimensions became prohibitive. In counterbalancing shunt excitation and preventing an excessive current rush during regeneration he advocated the employment of series turns; they were also invaluable for maintaining a certain degree of magnetisation, and preventing violent current rushes at the moment of making the series-parallel circuit changes by maintaining always a certain degree of magnetisation, without the aid of which the full magnetisation, so essential to choke back the current rush at this moment, could not be obtained quickly enough to be effective. These points were illustrated by diagrams showing, amongst other things, new and effective safety devices. Summing up the direct and indirect advantages of this three-fold use of the traction motor, they found them to be sufficiently substantial to warrant the conclusion that not only would the system soon come into general use, but that such use would speedily become so universal as to constitute it the standard system for all traction work. The system might also be readily adapted to tramway operation in connection with the multiple-unit control system; likewise the supplemental mechanical braking system. It would be observed in this connection that, as in the multiple-unit method of control, each car equipment, both as to its motor and its braking system, was a complete unit in itself, and might be controlled individually or in multiples with equal facility.

Preliminary tests made in October last on the Norwich tramways, under the supervision of Mr. A. N. Banister, chief engineer to the tramway company, showed that the regenerative car on the Johnson-Lundell system effected a saving in energy used per car-mile of about 30 per cent. on the average; the saving depended on the direction, varying, for example, from 64 to 16·9 per cent. on one route, and from 15·3 to 44 per cent. on another. The cars were driven by the tramway company's drivers, and the weather was wet. The regenerative car weighed about 1½ tons more than the ordinary car.

In the discussion of the paper which followed, the PRESIDENT said Mr. Johnson claimed to reduce the operating cost of tramway systems. His tentative experiments in Norwich showed a reduction in the cost of energy varying from 64 per cent. to 20 per cent.—a pretty wide margin, but he also claimed—and that was the most important part of the claim which he advanced—an immense addition to the controlling power of the man in charge of the tramway car.

Criticisms on minor points were advanced by various gentlemen, and at the close a hearty vote of thanks was accorded to Mr. Johnson for his paper.

EFFICIENCY OF DIRTY COALS.

IN a paper read before the Western Society of Engineers by Mr. W. L. Abbott some interesting remarks are made with reference to the efficiency of coal containing much ash. Though we rarely have to do with coals containing such ash percentages as 20 or 30, it may sometimes happen that the question of the use of such coals will come before the engineer, and as time goes on coal will be found to contain more rather than less dirt, if sold as it is got.

The question of washing coal is brought more into prominence, and incidentally also the use of gas power rather than steam power, for the loss of efficiency when dirty coal is used in a producer cannot approach the loss when it is used beneath steam boilers.

Mr. Abbott describes experiments made with coal screenings, which were burned under Babcock boilers with grate areas of 75 and 66 sq. ft. and heating surfaces of 5,000 and 4,000 sq. ft. Each boiler had a chain grate stoker. It was sought to discover the effect on capacity and efficiency of using different sizes of coal, the influence of the ash, the effect of variation in size of coal screenings and the results of different thicknesses of fire.

Thus one set of experiments was made with coal screened through square meshes of 0·25, 0·50, 0·75, 1·0 and 1·25 in. All the samples were screened from the same coal, and the smaller sizes consequently had the most ash, the percentages of ash of each of the above sizes being 30·8, 20·8, 15·6, 14·0 and 13·7 respectively. While the largest size gave an efficiency of just over 60 per cent., the efficiency rose to a maximum of 70 per cent. with the 0·75 size, fell to 65 with the 0·5 grade, and dropped to less than 30 per cent. with the smallest grading.

The capacity or boiler-power curve followed a similar, but steeper, curve with a maximum point near the 0·75 size on the side of the 1·0 size, but while the maximum capacity is 900 H.P., the minimum is only 100 H.P., showing that, with but little more dirt, the boiler would do little else than keep itself warm.

Ash acts as a diluent, displacing combustible matter, and in another series of tests made with a special washed coal passed over ¼-in. round openings, and through ½-in. round openings, it was found that with coal of 14·463 B.TH.U. when pure, and 13·176 B.TH.U. with 8·9 per cent. of ash, in the dry sample, a certain efficiency was attained. In subsequent tests ashes were added, and when the total ash was 40 per cent. of the whole mass, the useful effect was zero; that is to say, the boiler just managed to keep itself hot. Thus, with a fuel containing 60 per cent. combustible, no work external to the boiler could be performed, owing to the obstruction caused by the ash and the small amount of combustible on the rear end of the grates, so that much useless air entered and the temperature head of the gases above the heating surface was too small for useful effect, the general furnace temperature being reduced to perhaps 600° F., so that the boiler could not absorb more heat than what was required to balance radiation losses. This point is particularly emphasised, and it bears closely on much modern practice, showing the extreme fallacy of controlling furnace temperatures by the admission of excessive air with the view of enabling such things as superheaters to withstand the temperature of the gases brought against them. Needless almost to say that, so let down, the huge volume of low temperature gases which leaves a superheater is almost useless for further heating purposes.

Another set of tests was made to determine the effect of variation of size of coal screenings. Fine dust in excess is a great source of trouble, and washing the coal necessarily improves the coal by removing the dust. A coal sieved through a 0·25-in. square screen gave 108 H.P., and a washed coal through 0·25 round hole sieve gave 600 H.P., but not much of the difference is attributed to the reduction of ash by the washing. It is the dust to which the reduced capacity is attributed.

As regards thin and thick fires, the former give an excess of air and the latter tend to smoke. With a badly set boiler, the gases rising directly amongst the tubes, the best economy accompanied the most smoke, because with the chain grate and thick fire the air excess was reduced. About 5½ in. was the fire thickness for best capacity, but the efficiency did not vary. The paper is somewhat involved for complete and satisfactory abstract, but is an earnest attempt to discover laws bearing on coal sizes and ash contents. It is remarked that in 1905 there were produced 50 millions of tons of coal in Illinois and Indiana, and of this quantity 48 per cent. was 1¼-in. screenings; it can be truthfully said that this percentage, or 20 million tons, was sold at the mine at a price which, on an average, was not over two-thirds of the cost of production, and this fine coal was employed to make steam at an average efficiency of less than 50 per cent.

Such facts as these certainly warrant the further prosecution of the inquiry, for if substantiated, they point to the relatively enhanced value of large coal, and especially to the economy that would be obtained from gas engines, as compared with steam plant, given, of course, a suitable bituminous producer. Whether an investigation on similar lines into English coals would show the same general results, we can hardly say, but the subject is one of great importance, and tests ought to be made with rational furnaces properly constructed to burn bituminous coal without smoke, and not merely upon grates disposed directly below the water tubes of a boiler in a furnace hopeless of all possibility of suitable air

admixture and innocent of any means for maintaining temperature, pending the sufficient progress of combustion to warrant exposure of the gases to heat-absorbing influence.

CANADIAN TRADE.

Canada is a land of infinite possibilities—we are all saying that now. The frequent descriptions in the daily Press of her people's attainments, and hopes of attainment in the future, the recent remarkable speech by Earl Grey, the High Commissioner, and the other information that reaches each of us as members of the nation, all seem more like one great dream in which imagination makes its flight without restraint upon the rein. And the existence of this sort of thing makes anybody who is of an industrial or trading turn of mind consider, and consider again and again, the business position in general, and how, if worth while, he can in his own particular department take advantage of the coming development. In order to intelligently consider the matter, and to secure the best result, avoiding disappointment, the student of the market wants to know what is the extent of the present and probable demands, what are the existing arrangements for meeting it, the conditions as to manufacturing, competition, prices and so on. A great deal of this information he must collect for himself, but there is a certain amount of published official statistical matter to which he has access, and which may be of assistance to him. There is a disposition at present among some firms in England to try their hand at electrical dealings with Canada, and we may, perhaps, be allowed to remind them of some articles that appeared in the Electrical Review for December 30th, 1904, and February 10th and 17th, 1905.

In connection with these comments, we wish to draw attention to a publication which has just been received by us from the office of the High Commissioner for Canada, 17, Victoria Street, London, S.W. We mean the *Canadian Trade Index* which is issued by the Canadian Manufacturers' Association Incorporated, of Toronto, and is printed in English, French and Spanish. It contains a large map of Canada, an account of the objects and officers of the Association, a list of the members, and the classes of their manufactures, also some notes on the steamship service from Canada. From the statistical information given in the book, we glean the following figures:—

Foreign trade:—	1903.	1905.
Total imports	£49,530,783	£53,780,582
Total exports	£46,375,713	£41,748,835
Total trade	£95,905,850	£95,529,417
Per capita trade	£17	£17
Exports to Great Britain	£26,940,928	£20,936,092
Imports from Great Britain	£12,093,819	£12,390,700
Exports of manufactures:—		
Total	£4,698,188	£5,060,171

The railways of Canada are 21,000 miles (steam and electric), and 5,000 additional miles are under construction. The freight carried is set down as 50,000,000 tons, and the passengers as 25,000,000, for the last complete year. There are 15,000 factories, giving employment to 450,000 employés, and their output in manutures aggregates £123,203,285.

Of course, it is well known that various of the large American electrical companies have established factories in Canada, placing them in a more favourable position for competing than would be the case were they exporting from the States. But this should not deter British electrical firms who are now more anxious to develop foreign business from making a close study of the position. Any who are sufficiently interested in the matter can obtain a copy of this *Canadian Trade Index* by making application to the High Commissioner in London at the address already mentioned.

Another reminder of the brightne s of Canadian prospects, comes to hand in the shape of a "Special Engineering Issue" of *Canada*, a sixpenny weekly organ published at 52, Long Acre, W.C. This is a new paper, and special attention is directed to the opportunities in Canada for British machinery and engineering firms. It contains, among other matter, a special article by Sir Charles M'Laren, Bart., M.P., on "The Engineering Trade with Canada." Scottish trade with Canada is reviewed. "Bristol and its Engineering Resources" is the title of another article, and there are also contributions from Toronto and Montreal giving details of the openings which exist to-day. An illustrated article gives a fully illustrated description of the recently completed power works at Niagara.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

26,107. "New or improved electrical switch apparatus." M. Reinhardt. November 14th.

26,112. "Improvements in electrically-driven machines for vacuum dust extracting, said machines being applicable for cleaning carpets, hangings, clothes and the like." G. F. Higgins and The Light Electric Motor Co., Ltd. November 19th.

26,131. "Improvements in electrostatic voltmeters." E. J. Murphy and Kelvin & J. White, Ltd. November 19th.

26,144. "Improvements relating to the electrolytic deposition of metals." J. Taylor. November 19th.

26,148. "Improvements in or relating to controller systems chiefly for electrically propelled trains or vehicles." Siemens Bros.' Dynamo Works, Ltd., C. F. Jenkin and F. Lydall. November 19th. (Complete.)

26,152. "Improvements in braking electric hoists and the like." Siemens Bros.' Dynamo Works, Ltd. (Siemens Schuckertwerke, G.m.b.H., Germany.) November 19th. (Complete.)

26,154. "Improvements in and connected with the control of the ignition in internal combustion engines." A. Jack. November 19th. (Complete.)

26,170. "Improvements in electrical measuring instruments of the resonance type." Hartmann & Braun Actien Gesellschaft. (Date applied for under Patents Act, 1901, November 20th, 1905, being date of application in Germany.) November 19th. (Complete.)

26,211. "Improvements in the electrolytic production of metallic sheets, tubes, wire, strip or the like." S. O. Cowper-Coles. November 19th.

26,212. "Improvements in or connected with anodes for electro-deposition." S. O. Cowper-Coles. November 19th.

26,219. "Electric signalling installation." H. Schorn. (Date applied for under Patents Act, 1901, November 20th, 1905, being date of application in Switzerland.) November 20th. (Complete.)

26,290. "Improvements in method of and means for insulating the supports of electric conductors." C. E. Egner. November 20th.

26,291. "Improvements in the manufacture and construction of incandescent electric lamps." W. Defries. November 20th.

26,301. "Improved automatic telephone district system and means for use in automatic telephony." R. W. James. (The Automatic Electric Co., United States.) November 20th. (Complete.)

26,351. "Improvements in single-phase commutator motors." T. W. Broadbent and F. W. Davies. November 21st.

26,355. "Improvements relating to electric switches." H. C. J. Fox and Drake & Gorham, Ltd. November 21st.

24,382. "Improved electric lamp-shade adjuster." F. R. Connell. November 21st.

26,404. "Improved means for securing magneto-electric machines to their supports." F. R. Simms. November 21st.

26,405. "Improvements in ignition plugs." F. R. Simms. November 21st.

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